SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 19
OCTOBER 1, 1969

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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01. NATURE OF WATER

1A. Properties

APPLICATION OF THE HYDRAULIC ANALOGY TO FIELD AMPLIFIER DESIGN (FRENCH),
Department of Sciences, Toulouse (France).
For primary bibliographic entry see Field 02A.
W69-08020

02. WATER CYCLE

2A. General

ADVANCES IN HYDROSCIENCE.

Chow, Ven Te, Editor. Advances in Hydroscience, Vol 5, 1969. 305 p, 127 fig, 18 tab, 383 ref, 2 index.

Descriptors: *Reviews, *Bibliographies, *Groundwater movement, *Stochastic processes, *Snow, Seepage, Infiltration, Snowpacks, Mathematical models, Model studies, Mathematical studies, Soil physics, Open channels.
Identifiers: Stochastic hydrology, Snow physics.

Recent advances in stochastic hydrology, subsurface flow, and snow physics are reviewed. Stochastic hydrology helps in the design of water resource systems by use of analytical or simulation models. Mathematical and physical work in open-channel seepage and in soil water movement permits good water conveyance design work and subsurface water determinations. Recent work in snow physics includes study of metamorphism, diffusion, vapor transport, and radiation properties. See also W69-07724 thru W69-07727. (Knapp-USGS)
W69-07723

TIME SERIES ANALYSIS OF HYDROLOGIC DATA,
Arizona Univ., Tucson. Office of Hydrology and Water Resources.
For primary bibliographic entry see Field 07C.
W69-07724

SIMULTANEOUS USE OF AN ANALOG SINGLE-PURPOSE ELECTRONIC COMPUTER AND A PHYSICAL MODEL OF A WATERSHED,
Prague Agricultural Univ. (Czechoslovakia). Dept. of Water Resources.
Jarcmir Nemec.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 10-14, 1968. 5 p, 2 fig, 7 ref.

Descriptors: *Analog computers, *Analog models, *Model studies, *Hydrograph analysis, Floods, Rainfall-runoff relationships, Hydraulic models, Parametric hydrology, Mathematical models, Routing, Flood routing.
Identifiers: Flood hydrographs.

To analyze the time element of flood hydrographs of surface runoff, use is made of a single-purpose electronic resistance-capacitance computer containing 6 RC units with a non-linearity element. The time lag constants of the computer are selected on the basis of measured time lags from a physical scaled model of an experimental watershed on which the floods are simulated by a sprinkler. The resulting hydrographs from the analog computer and the physical model are compared at various intensities and durations of rain. The study is directed toward an interconnection of the analog computer and the physical model. (Knapp-USGS)
W69-07743

WATERSHED SIMULATION BY ELECTRONIC ANALOG COMPUTER,
Utah Water Research Lab., Logan.
J. Paul Riley, Duane Chadwick, and Eugene Israelsen.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 25-37, 1968. 13 p, 9 fig, 11 ref.

Descriptors: *Analog models, *River basin development, Water demand, Water supply, Hydrographs, Hydrograph analysis, Streamflow, Streamflow forecasting, Rainfall-runoff relationships, Resistance networks, Simulation analysis.
Identifiers: Watershed simulation.

At Utah State University the consequences of man-made hydrologic changes in drainage basins are being approached by electronic analog simulation. A model is developed for investigating the behavior or response of a dynamic prototype system subject to particular constraints and input functions. Simulation permits an examination of the composite system involving all processes occurring simultaneously. Thus, a model is not only an excellent exploratory tool, but also a direct aid to creative thinking. A model can greatly facilitate an appraisal of proposed changes within a prototype system. A fundamental requirement of a computer model of a physical system is that it simulate on a continuous basis all important processes and relationships within the system that it represents. The various functions and operations of the different parts of the system are interrelated by the concepts of continuity of mass and momentum. Many of the processes which occur in hydrologic systems can be represented by time-dependent differential equations. For the solution of this equation form, the analog computer is particularly adept because it can integrate problem variables on a continuous basis. Close agreement with observed outflow hydrographs has been achieved in several model experiments. Analog computer simulation seems capable of making substantial contributions both in the area of basic water related research, and also as a planning and management technique in seeking optimum use of existing water supplies. (Knapp-USGS)
W69-07744

ELECTROLYTIC TANK TYPE MODELS FOR PREDICTING THE POSITION OF THE GROUNDWATER TABLE AND THE LOSS OF RIVER DISCHARGES,
Research Inst. for Water Resources Development, Budapest (Hungary).
E. Varrok.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, pp 3-9, 1968. Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 3-9, 1968. 7 p, 8 fig.

Descriptors: *Analog models, *Surface-groundwater relationships, Induced infiltration, Bank storage, Dams, Aquifers, Reservoirs, Resistance networks, Electrolytes, Model studies.
Identifiers: Hungary, Danube River, Resistivity models, Electrolytic analog models.

Groundwater levels on riverside areas may be predicted by electrolytic tank models and automatic devices. On the 73 km long stretch of the Danube River between river stations 1795 and 1868 km, hydroelectric development has been contemplated. Here the river flows on the ridge of an alluvial deposit, and influences the water table on both sides. On the right side an area of about 800 sq km is influenced. The gravel aquifer overlying the impermeable bottom is from 50 to 300 m deep. The area was reproduced in an electrolyte type model to 1:25,000 scale, with the bottom relief made of synthetic resin. The slope of the water surface in the rivers bordering and crossing the area, and also the anisotropy of the aquifer were taken into consideration. This model was used to predict the position of water table, its depth under the terrain, the discharge filtering into the draining canals and the total seepage loss from the river. For models of this type automatic equipment has been developed to find the preselected equipotential lines and follow them automatically, tracing their path on an adjacent drawing board to the scale of the model. (Knapp-USGS)
W69-07949

ELECTRICAL-ANALOG ANALYSIS OF THE HYDROLOGIC SYSTEM IN TUCSON BASIN, ARIZONA, U.S.A.,
Geological Survey, Tucson, Ariz.
For primary bibliographic entry see Field 02F.
W69-07950

THE MAR ANALOG COMPUTER FOR MODELLING HYDROLOGICAL SERIES BY THE MONTE CARLO METHOD,
G. G. Okroashvili, and G. G. Svanidze.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol Pub No 80, pp 81-86, 1968. 6 p, 5 fig, 4 ref.

Descriptors: *Analog computers, *Runoff forecasting, Monte Carlo method, Markov processes, Stochastic processes, Reservoir operation, Streamflow forecasting, Water management (Applied), Routing, Statistical methods.
Identifiers: *USSR.

An analog computer is used in the USSR for modelling annual runoff fluctuations, given the statistical characteristics of the rainfall-runoff relationship. The probability of storage of reservoirs may also be computed. A description of the computer is given and its operation is discussed. (Knapp-USGS)
W69-07954

DIGITAL COMPUTER SOLUTIONS FOR FLOOD HYDROGRAPH PREDICTION FROM RAINFALL DATA,
Technische Hochschule, Munich (West Germany). Hydraulics Research Station Obernach.
Gert A. Schultz.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 125-137, 1968. 13 p, 9 fig, 3 tab, 11 ref.

Descriptors: *Mathematical models, *Computer models, *Digital computers, *Rainfall-runoff relationships, *Flood forecasting, Synthetic hydrology, Hydrographs, River forecasting, Rainfall disposition, Computer programs, Unit hydrographs.
Identifiers: Germany, Hydrograph synthesis.

A linear distributed-system model for flood hydrograph synthesis was applied to 2 characteristic test catchments (up to 700 sq mi in area) in central Europe, one of which was an Alpine watershed. The method uses very small elements, both in time and space, which made the use of a digital computer inevitable. The calculations were performed by a Telefunken TR 4 computer (80,000 operations/sec) using an ALGOL code program. The mathematical model uses as input information rainfall data consisting of temporal and spatial distribution and catchment characteristics. The output consists of a digital flood method in which the hydrological deviation between the observed and the synthesized hydrograph is calculated. The 30 synthesized floods were compared with the results gained by applying the conventional Unit Hydrograph method (also calculated by an ALGOL-code computer program) to the same floods. The results show that the new model produces a higher average accuracy than the conventional Unitgraph method. Furthermore it was possible to show that the accuracy of the model in contrast to the Unitgraph method, did not deteriorate with increasing catchment area. (Knapp-USGS)
W69-07958

DETERMINATION OF THE RUNOFF HYDROGRAPH ON A DETERMINISTIC BASIS USING A DIGITAL COMPUTER,
Technical Univ. of Budapest (Hungary).
M. Kozak.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub no 80, Vol 1, pp 138-151, 1968. 14 p, 8 fig, 10 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Computer models, *Digital computers, Computer programs, Synthetic hydrology, Rainfall disposition, Rainfall intensity, Hydrographs, Hydrograph analysis.
Identifiers: Hungary.

The two main prerequisites for the exact determination of runoff discharge from catchments are the knowledge of the linear charge and the computation of resulting flow conditions in the canal network with due allowance for the non-steady character of flow. The catchment area is divided first into catchment strips and these in turn into fields having homogeneous parameters. For deriving a solution for the problem the equation expressing the mean velocity of sheet flow is included. The linear charge is obtained as the combined effect of runoff originating from catchment fields situated successively downstream. Allowance for the main parameters of each field--which vary with respect to location and time alike and affect runoff conditions--is made by the division into fields. Allowance can also be made for variations of rainfall intensity in both time and space. For solving the resulting differential equation a mathematical program has been compiled, and its application is illustrated by a representative example. From the results of mechanical computation it could be concluded that essential, but hitherto not clearly understood features of the involved hydraulic phenomenon, are revealed in greater detail by computations relying on more exact theoretical foundations. (Knapp-USGS)
W69-07959

APPLICATION OF THE HYDRAULIC ANALOGY TO FIELD AMPLIFIER DESIGN (FRENCH),
Department of Sciences, Toulouse (France).
J. Dat, and C. Fonade.
La Houille Blanche, Vol 24, No 1, pp 35-43, 1969. 9 p, 5 fig, 16 ref.

Descriptors: *Analog models, *Mathematical studies, *Mathematical models, Hydraulic design, Fluid mechanics, Runoff, Channels, Compressible flow, Pressure, Stokes law, Temperature, Energy equation, Viscous flow, Velocity, Heat flow.
Identifiers: *Hydraulic analogy design.

The application of the hydraulic analogy to hydrological problems was investigated on the basis of the solution of 6 equations: (1) continuity; (2) Navier and Stokes' 3 equations of motion; (3) conservation of energy; and (4) pressure-volume-temperature equation. The study shows that, by neglecting fluid viscosity, the polyotropic index (the ratio of specific heat at constant pressure to specific heat at constant volume) is 2. The study also shows that by assuming geometrical similarity there is an analogy between the depth of water in a free-surface model and the density of the fluid under pressure. The last conclusion is equivalent to setting the pressure flow Mach number equal to the Froude number for free-surface flow. An example given in the article indicates that this analogy can be achieved in practice. (Gabriel-USGS)
W69-08020

FUNCTION SPACE APPROACH TO PARAMETER IDENTIFICATION IN DISTRIBUTED SYSTEMS,
Hitachi Research Lab., Ibaraki (Japan); and California Univ., Los Angeles.
Yukio Kawamoto, and Jacques J. Vidal.
Water Resources Res Center Publication (undated). 4 p, 1 fig, 3 ref. OWRR Project No A-032-CAL.

Descriptors: *Mathematical models, *Digital computers, *Analytical techniques, *Computer programs, Data processing, Synthetic hydrology, Numerical analysis, Parametric hydrology, Simulation analysis.
Identifiers: Partial differential equations.

The solution of partial differential equations describing realistic physical problems can place a heavy burden on even the largest and fastest computers. Moreover, if the problem is one of synthesis such as parameter identification, repeated solving of the equations are called for, rendering the computing outlook even more critical. This is especially true if the parameter values at each node are considered independent elements of a multivariable system. The alternate approach discussed here reduces the problem to one of optimal control in function space. A compact algorithm is derived to identify parameters that are distributed functions by iterative updating over the whole space and time domains. (Knapp-USGS)
W69-08023

THE EFFECT OF CASPIAN SEA LEVEL OSCILLATIONS ON EVAPORATION INTENSITY FROM ITS SURFACE (RUSSIAN),
For primary bibliographic entry see Field 02D.
W69-08030

A NUMERICAL MODEL FOR THE SIMULATION OF TIDAL HYDRODYNAMICS IN SHALLOW IRREGULAR ESTUARIES,
Texas Univ., Austin. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02L.
W69-08112

HYDROLOGIC ANALYSIS FOR LAKE ONTARIO: STOCHASTIC ASPECTS OF EVAPORATION.
Cornell Univ., Ithaca. School of Civil Engineering.
For primary bibliographic entry see Field 02D.
W69-08116

2B. Precipitation

SPECIALIZED ANALOG COMPUTERS FOR HYDROLOGICAL CALCULATIONS AND FORECASTS,
Hydrometeorological Centre, Moscow (USSR).
For primary bibliographic entry see Field 07C.
W69-07952

HYDROLOGIC REGIONS IN BULGARIA (BULGARIAN),
For primary bibliographic entry see Field 02E.
W69-07979

TROPICAL RAINFALL VARIATIONS OVER A SMALL AREA,
University Coll., Dar-es-Salaam (Tanzania). Dept. of Geography.
I. J. Jackson.
J Hydrol, Vol 8, No 1, pp 99-110, May 1969. 11 p, 2 fig, 3 tab, 5 ref.

Descriptors: *Rainfall, *Rainfall disposition, Rain gages, Sampling, Statistical methods, Regression analysis, Tropic, Climatic zones, Humid climates, Storms.
Identifiers: Tanzania.

The large spatial variation of daily and monthly rainfall over an area of about 2 sq mi is analyzed. The variation is the result of storm tracks rather than relief. Little difference was found in the assessment by 3 different methods of mean depth of rainfall over the area. The 10 rain gages used were found to be barely adequate for an accurate estimation of mean depth. (Knapp-USGS)
W69-08007

2C. Snow, Ice, and Frost

ADVANCES IN HYDROSCIENCE.
For primary bibliographic entry see Field 02A.
W69-07723

RECENT STUDIES ON SNOW PROPERTIES,
Army Terrestrial Sciences Center, Hanover, N. H.
Yin-Chao Yen.
Advance in Hydroscience, Vol 5, pp 173-214, 1969. 42 p, 21 fig, 4 tab, 33 ref.

Descriptors: *Snow, *Physical properties, Density, Diffusivity, Optical properties, Thermal conductivity, Albedo, Avalanches, Density stratification.
Identifiers: Snow metamorphism, Snow structure.

Recent work in snow metamorphism, sintering, thermal properties, and radiation properties is summarized. Methods for determining thermal conductivity and water vapor diffusivity are discussed. Theoretical and measured values of thermal conductivity, thermal diffusivity, vapor diffusion, and radiant energy transport in snow are discussed and compared. For main entry see W69-07723. (Knapp-USGS)
W69-07726

GLACIER MOVEMENT IN THE MIRNYY AREA (RUSSIAN),
Arkticheskii i Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR).
Ya P. Koblents.
Informatzionnyy Byulleten' 70, Sovetskoy Antarkticheskoy Ekspeditsii, pp 32-35, 1968. 4 p, 1 fig, 1 tab, 2 ref.

Descriptors: *Glaciers, *Antarctic, Mapping, Snow, Temperature, Movement, Velocity, Fissures (Geology), Erosion.
Identifiers: Antarctic glacier movement.

Glacier movements in the vicinity of the Mirnyy station of Antarctica were investigated by using a careful mapping of the pertinent points of the station. The study shows that the maximum displacement of the surveyed objects was 7 m during the 10 study years. Such a speed of motion, however, cannot be considered as dangerous for the preservations of buildings at the station. (Gabriel-USGS).
W69-07751

STRUCTURE, BASIC PROPERTIES, AND STRENGTH OF MARINE ANTARCTIC ICE (RUSSIAN),
Leningrad State Univ. (USSR).
V. Kh. Buynitskiy.
Informatzionnyy Byulleten' 65, Sovetskoy Antarkicheskoy Ekspeditsii, pp 90-104, 1967. 15 p, 4 fig, 3 tab, 21 ref.

Descriptors: *Ice, *Antarctic, *Strength, *Structure, Frazil ice, Snow, Crystallization, Winter, Salinity, Density, Summer, Seasonal, Temperature.
Identifiers: Marine Antarctic ice.

Marine Antarctic ice properties were investigated on the basis of earlier publications and the results are given as the curves of ice salinity, density, and strength, as a function of season, temperature and oceanic depth. The study shows that the density of ice varies from 0.810 to 0.950 and its vertical distribution in its annual ice layer is considerably different from the vertical salinity distribution. The strength of Antarctic ice in bending varies from 0.1 to 47. kg/sq cm, as a result of an extremely complicated and heterogeneous structure of the Antarctic ice. (Gabriel-USGS)
W69-07767

STORBREEN CLACIER IN VOTUNHEIMEN, NORWAY,
Norsk Polarinstitutt, Oslo.

Olav Liestol.
Norsk Polarinstitutt Nkr No 141, 1967. 63 p, 43 fig, 5 tab, 33 ref.

Descriptors: *Glaciers, Mass, Ablation, Hydrologic data, Mathematical studies, Meteorological data, Photogrammetry, Mapping, Convection, Radiation, Condensation, Summer, Firn, Sediment load, Temperature, Density, Snow, Snowmelt, Freezing, Velocity.
Identifiers: *Norway, Storbreen glacier.

This study represents the results of the investigations conducted during the 1949-1965 period and consisting of glacio-meteorological observations and the measurements of accumulation, ablation, and mass balance taking place in the Storbreen Glacier area. The study shows a good agreement between the mass balance calculated on the basis of volume calculations from accurate photogrammetric maps and the balance evaluated from direct observations. The calculated values of mass balance are also in good agreement with the length variation of different glaciers. The article also gives some data on the glacier movement and its sediment load. (Gabriel-USGS)
W69-07768

RESEARCH ON GLACIER ACTIVITY (GERMAN),
KIEL UNIV. (West Germany).
Gerhard Vorndran.
Schr Geogr Instit der Univ Kiel, Vol 29, No 1, 1968. 131 p, 33 fig, 19 tab, 235 ref.

Descriptors: *Glaciers, *Alpine, *Climates, *Hypsometric analysis, Climatic data, Mapping, Snow survey, Ice, Mathematical studies, Glacial drift, Accelerated erosion, Altitude, Snow cover, Cirques, Movement.
Identifiers: *Alps (Eastern), German glacier activity.

Glaciological research in the Eastern Alps (Silvretta group) in 1966 and 1967 shows that about 1860, when the last glacier maximum was reached, the climatic snow line was 100 m lower than now. The ice-covered area was twice as large as in 1952 - 59. In 100 yr, the permanent glacier retreat was interrupted only once by a short advance in 1915-20. After 1860 large glaciers quickly lost in volume because they extended 450 m, or more, below snow line, but because of their thickness (greater than 100 m) only a small area became ice free. About 1920 the unretarded glaciers advanced while the tongue glaciers remained stationary. Hypsographic curves of the most retarded glaciers are convex whereas those of the cirque glaciers are concave. (Lang-USGS)
W69-07968

PHYSICS OF ICE,
McGill Univ., Montreal (Quebec). Dept. of Physics.
Elton R. Pounder.
Oxford, Pergamon Press Ltd, 1965. 151 p, 31 fig, 5 tab, 70 ref.

Descriptors: *Ice, *Freezing, *Melting, Sea ice, Lake ice, Streams, Frazil ice, Cryology, Crystals, Ice breakup, Ice loads, Ice jams.
Identifiers: *Ice physics, *Ice chemistry, Ice mechanics.

The present state of knowledge of the structure and properties of ice is outlined in a book written primarily for use by readers with knowledge of basic mathematics, physics, and chemistry. The topics discussed include sea ice, ice drift, ice control, crystallography, mechanical properties, thermal properties, chemical properties, and ice-cover growth and decay. (Knapp-USGS)
W69-08057

2D. Evaporation and Transpiration

PEAK FLOW REQUIREMENTS FOR SPRINKLER IRRIGATION OF ORCHARDS AS AFFECTED BY SOIL TEXTURE AND PEAK EVAPOTRANSPIRATION,
Department of Agriculture, Summerland (British Columbia).
For primary bibliographic entry see Field 03F.
W69-07780

EVAPOTRANSPIRATION BY WOODY PHREATOPHYTES,
Geological Survey, Carson City, Nev.
Otto M. Grosz.
Nev Dep Conserv and Natur Resources, Div of Forest, 10th Progr Rep, pp 1-5, Apr 1969. 5 p, 1 fig, 2 tab.

Descriptors: *Evapotranspiration, *Phreatophytes, *Nevada, Lysimeters, Soil moisture, Water table, Water-level fluctuations, Rabbitbrush, Willow trees.
Identifiers: *Winnemucca (Nev), Greasewood, Wildrose.

A lysimeter study near Winnemucca, Nev. was initiated in 1959 to measure water consumption by greasewood, willow, wildrose, and rabbitbrush. In the 1968 season, July maximum temperature was 93 deg F and the minimum was 53 deg F, slightly above the normal. August temperatures were 9 deg below normal. Water use, soil moisture, and evaporation were measured periodically and the 1968 data are tabulated. Monthly temperature, rainfall, and pan evaporation are shown graphically. (Knapp-USGS)
W69-07928

THE EFFECT OF CASPIAN SEA LEVEL OSCILLATIONS ON EVAPORATION INTENSITY FROM ITS SURFACE (RUSSIAN),
R. L. Reyfman.
Izv Acad Nauk, Azerboydzhanskoy, SSR, No 5, pp 121-127, 1968. 7 p, 1 fig, 9 ref.

Descriptors: *Evaporation, *Evaporation control, *Sea level, Water balance, Water loss, Water supply, Runoff, Hydrologic properties, Mathematical models, Humidity, Wind velocity, Ice, Freezing, Temperature.
Identifiers: *Caspian Sea, Surface evaporation.

Caspian Sea surface evaporation was investigated on the basis of earlier publications and application of the V.S. Samoylenko evaporation formula (1963), by connecting an evaporation layer in mm, mean monthly air-vapor pressure deficit in mbar, and mean wind velocity in m/sec. On the basis of the analysis of the available material and assuming some probable evaporation changes for various levels of the Caspian Sea, a schematic map of probable evaporation values was constructed for a two-meter decrease of the Caspian Sea level. The study shows that under present conditions of measurement accuracy a 2-3 meter decrease in the Caspian Sea level would not affect the volume of evaporated water over the Caspian Sea surface. (Gabriel-USGS)
W69-08030

HYDROLOGIC ANALYSIS FOR LAKE ONTARIO: STOCHASTIC ASPECTS OF EVAPORATION.
Cornell Univ., Ithaca. School of Civil Engineering.

Research Project Technical Completion Report No 12, of the Water Resources and Marine Sciences Center, June, 1969. 75 p, 12 tab, 15 fig, 52 ref. OWRR Project A-009-NY.

Descriptors: *Stochastic processes, *Evaporation, Mass transfer, Model studies, Hydrologic budget, *Lake Ontario, Hydrologic cycle, Water balance.
Identifiers: *Lake hydrology.

Before a complete analysis can be made of Lake Ontario as a hydrologic system, a sufficiently accurate estimate must be available of the evaporation component of the hydrologic cycle. Therefore, monthly mean values of evaporation from Lake Ontario for the period 1872-1965 were generated by a mass-transfer procedure. Available on-shore recorded meteorological data were adjusted to obtain approximate over-lake values. The mass-transfer coefficient was calculated with an equation by Harbeck (1962) relating it with water surface area. Correlation and spectral analyses showed that the annual cycle was predominating in the evaporation--and in the related meteorological time series. Evaporation is usually high in fall and winter and low in spring and summer. A warming trend was observed in the air temperature and a drying trend in the relative humidity series. Cross correlation and cross spectral analyses showed a close relationship between evaporation anomalies and the related meteorological parameters. A first order Markov model described adequately the evaporation, air temperature and relative humidity anomalies whereas a second order model could fit the wind speed and water surface temperature anomalies. Comparison of the mass-transfer evaporation data with Morton's (1967) water-budget estimates revealed that on the average the two methods are comparable. The water-budget method yields higher evaporation estimates in the summer and lower estimates in the winter.
W69-08116

2E. Streamflow and Runoff

ON THE HIGH REYNOLDS NUMBER FLOW OVER A WAVY BOUNDARY,
California Univ., San Diego, La Jolla. Inst. of Geophysics and Planetary Physics.
Russ E. Davis.
J Fluid Mech, Vol 36, Part 2, pp 337-346, Apr 14, 1969. Contract No Nonr-2216 (29)-ONR, Grant No GA-849-NSF.

Descriptors: *Waves (Water), *Viscous flow, *Turbulent flow, *Fluid mechanics, Reynolds number, Laminar flow, Interfaces, Shear, Viscosity, Roughness (Hydraulic).
Identifiers: Shear flow, Rayleigh number.

The nature of a shear flow over a wavy boundary of small amplitude is investigated. It is found that if the viscosity is small, the nature of the flow is highly dependent on the wave amplitude. If the wave amplitude is truly infinitesimal, the flow is described by the Orr-Sommerfeld equation and in the neighbourhood of the critical layer viscous stresses are important even in the limit of vanishing viscosity. However, if the wave is sufficiently large, viscous stresses may be neglected even in the critical layer. An approximate solution of the inviscid equations of motion is obtained to describe the flow over a small but finite wave in the limit of infinite Reynolds number. (Knapp-USGS)
W69-07705

HYDROGRAPH SYNTHESIS BY DIGITAL COMPUTER,
Texas A and M Univ., College Station. Dept. of Meteorology.
Michael D. Hudlow, and Robert A. Clark.
ASCE Proc, J Hydraul Div, Vol 95, No HY3, Pap No 6555, pp 839-860, May 1969. 21 p, 15 fig, 3 tab, 20 ref, append.

Descriptors: *Hydrographs, *Synthetic hydrology, *Unit hydrographs, Hydrograph analysis, Mathematical models, Digital computers, Flood forecasting, Numerical analysis, Streamflow forecasting, Runoff forecasting, Mathematical studies, Statistical methods.
Identifiers: *Hydrograph synthesis.

Hydrograph synthesis is based on an investigation of runoff from small drainage basins in Texas, using a technique for determination of the temporal distribution of infiltration capacity. Correlations are made between a critical hydrograph parameter,

lag, and basin characteristics. Also, correlations are made between basin characteristics and the coefficients from Snyder's synthetic unit-hydrograph equations. A method for fitting hydrograph data to mathematical functions is developed. A nonlinear least-squares method is presented for fitting the 7 points obtained by a modified Snyder procedure to the Pearson type III mathematical function. (Knapp-USGS)
W69-07706

FLOOD PLAIN INFORMATION-GOODNIGHT ARROYO, DRY CREEK AND WILD HORSE-DRY CREEK, PUEBLO, COLORADO.
Corps of Engineers, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04A.
W69-07708

FLOOD PLAIN INFORMATION OF ARKANSAS RIVER AND TRIBUTARIES, RUSSELLVILLE AND DARDANELLE, ARKANSAS.
Corps of Engineers, Little Rock, Ark.
For primary bibliographic entry see Field 04A.
W69-07715

FLOOD PLAIN INFORMATION OF SWEETWATER RIVER, SAN DIEGO COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W69-07716

FLOOD PLAIN INFORMATION OF CANY CREEK IN VICINITY OF JACKSON, MISSISSIPPI.
Corps of Engineers, Mobile, Ala.
For primary bibliographic entry see Field 04A.
W69-07717

FLOOD PLAIN INFORMATION OF MASON CREEK AT SALEM, VIRGINIA.
Corps of Engineers, Wilmington, N. C.
For primary bibliographic entry see Field 04A.
W69-07718

A WATER BUDGET OF THE CARSON VALLEY, NEVADA,
Geological Survey, Washington, D. C.
Arthur M. Piper.
Geol Surv Prof Pap 417-F, 1969. 8 p, 1 fig, 1 plate, 7 tab, 1 ref.

Descriptors: *Hydrologic budget, *Nevada, *Runoff, Streamflow, Evapotranspiration, Comsumptive use, Irrigation, Rainfall, Discharge (Water), Inflow, Water balance.
Identifiers: Carson Valley (Nev), Water budget.

The water budget of Carson Valley, Nevada is estimated. Total annual inflow is 363,500 acre-ft, outflow is 286,300 acre-ft, and consumption is 77,200 acre-ft. Total runoff is calculated on the basis of estimated horizontal and vertical runoff variation and gaged streamflow into the valley. Water consumption is also estimated for natural or non-irrigated conditions. (Knapp-USGS)
W69-07733

WATER RESOURCES OF THE BELLE RIVER BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
W69-07734

FLOODS AT AMESVILLE, OHIO,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
W69-07735

FLOODS IN WILTON CENTER QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
W69-07736

FLOODS ON LITTLE BUFFALO CREEK AT WEST JEFFERSON, NORTH CAROLINA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
W69-07737

FLOOD PLAIN INFORMATION ON TIDAL LANDS AND COHANSEY RIVER IN CUMBERLAND COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W69-07739

FLOOD PLAIN INFORMATION - TIDAL LANDS AND MAURICE RIVER CUMBERLAND COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W69-07740

FLOOD PLAIN INFORMATION-CHARLOTTE AND MECKLENBURG COUNTY-NORTH CAROLINA.
Corps of Engineers, Charleston, S. C.
For primary bibliographic entry see Field 04A.
W69-07741

CHANGES IN THE CHANNEL MORPHOLOGY OF TRINITY RIVER AND EIGHT TRIBUTARIES IN CALIFORNIA, 1961-65,
Geological Survey, Menlo Park, Calif.
John R. Ritter.
Geol Surv Open-file Rep, Aug 1, 1968. 60 p, 27 fig, 9 tab, 17 ref.

Descriptors: *Channel morphology, *Alluvial channels, *California, Banks, Streamflow, Sediment load, Beds, Channel erosion, Discharge (Water), Regime, Shape, Sands, Gravels.
Identifiers: *Trinity River (Calif).

Most of the changes from 1961 to 1965 in the channel morphology of a 40-mile reach of the Trinity River in California were caused by the devastating flood of Christmas week, 1964, and perhaps to a lesser extent by the regulation of flow from Lewiston and Trinity Dams. The magnitudes of the changes in the Channel were recorded by means of repeated surveys of cross sections of the river located near the mouths of 8 tributaries. The greatest changes occurred near the mouths of North Fork Trinity River and Canyon Creek which were the farthest downstream of the 8 tributaries. Banks were eroded laterally as much as 140 ft and as much as 11 ft of deposition occurred in some areas. As the bed of the Trinity River is composed mostly of cobbles and pebbles, the maximum size of bed material moved during the flood was at least cobble and probably boulder. Erosion of the bed occurred at almost every section. The maximum recorded erosion of the thalweg was 1.7 ft; the maximum aggradation, 4.7 ft. Except for 1 section, the pool and riffle pattern indicated by the cross sections remained the same for 1961-65. At eroded locations the bed material became coarser; at aggraded locations, finer. (Knapp-USGS)
W69-07747

TYPICAL FREQUENCY CURVES OF MEAN DAILY DISCHARGES OF WATER AND NATURAL REGULATED FLOW OF TADZHIKISTAN RIVERS (RUSSIAN),
Akademiya Nauk Tadzhikskoi SSR, Dushanbe.
A. G. Trestman.
Dokl Akad Nauk Tadzh SSR, Vol 11, No 10, pp 41-45, 1968. 5 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Streamflow, *Frequency, *Regulated flow, Discharge (Water), Hydrologic properties, Gaging stations, Rivers, Runoff, Snowmelt, Water supply, Water sources, Glaciers, Precipitation (Atmosphere), Rain.
Identifiers: *Tadzhikistan Rivers (Russia), River flow frequency curves.

Frequencies of mean daily discharges of the Tadzhikistan Rivers were analyzed on the basis of data recorded, on the average, during 14-year periods at 80 hydrological stations located on 62 rivers of the area. By subdividing the Tadzhikistan area into 5 sections on the basis of their general geographical and climatic characteristics and taking into consideration the river--feeding type, i.e. snowmelt, glaciers, etc., the author developed a detailed table of mean daily discharge frequencies and of the coefficients of natural regulated flows. (Gabriel-USGS)
W69-07748

FLOW DURATION OF OHIO STREAMS,
Geological Survey, Columbus, Ohio.
For primary bibliographic entry see Field 07C.
W69-07753

FLOOD PLAIN INFORMATION OF CHARLES RIVER, MEDWAY, MASSACHUSETTS,
Corps of Engineers, Waltham, Mass.
For primary bibliographic entry see Field 04A.
W69-07764

FLOOD PLAIN INFORMATION-MANATI RIVER, PUERTO RICO,
Corps of Engineers, Jacksonville, Fla.
For primary bibliographic entry see Field 04A.
W69-07765

FLOOD PLAIN INFORMATION, COTTONWOOD CREEK, GRAND PRAIRIE AND ARLINGTON, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 04A.
W69-07929

COMPUTER APPLICATIONS IN HYDROLOGY IN KANSAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 07C.
W69-07930

HYDROLOGIC DATA: 1967, VOLUME 5: SOUTHERN CALIFORNIA,
California State Dept. of Water Resources, Sacramento.
John L. Lewis.
Calif Dep Water Resources Bull No 130-67, Jan 1969. 259 p, 18 fig, 11 tab, 3 append.

Descriptors: *Data collections, *Water quality, *California, Surface waters, Groundwater, Waste water disposal, Stream gages, Sampling, Water wells, Groundwater basins.
Identifiers: Southern California water quality, 1967 water year.

Surface water quality, groundwater quality, and wastewater quantity and quality data for the 1966-67 water year for Southern California are tabulated. Locations of surface water sampling stations, groundwater basins, and waste discharges are shown. (Knapp-USGS)
W69-07933

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO THE EVALUATION ON THE EFFECTS OF URBANIZATION OF THE RUNOFF CHARACTERISTICS OF SMALL WATERSHEDS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 04C.
W69-07951

SPECIALIZED ANALOG COMPUTERS FOR HYDROLOGICAL CALCULATIONS AND FORECASTS,
Hydrometeorological Centre, Moscow (USSR).
For primary bibliographic entry see Field 07C.
W69-07952

THE SOLUTION OF DIRECT AND INVERSE PROBLEMS OF OUTLET WAVES SPREADING ON ANALOG COMPUTERS,
Ministry of Reclamation and Water Economy, Erevan (USSR). Water Problems and Hydrotechnics Research Inst.
For primary bibliographic entry see Field 07C.
W69-07953

THE MAR ANALOG COMPUTER FOR MODELLING HYDROLOGICAL SERIES BY THE MONTE CARLO METHOD,
For primary bibliographic entry see Field 02A.
W69-07954

ESTIMATION OF FLOODS WITH THE AID OF ANALOGUE COMPUTERS,
Gidrometeorologicheskii Institut, Leningrad (USSR).
D. L. Sokolovsky, and I. A. Shiklomanov.
Int Ass Sci Hydrol, Pub No 80, Vol 1, Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, pp 87-94, 1968. 8 p, 2 fig, 8 ref.

Descriptors: *Analog computers, *Flood forecasting, *Flood routing, Resistance networks, Analog models, Hydrographs, Hydrograph analysis, Routing, Water management (Applied), River forecasting.
Identifiers: *USSR.

Methods of estimation of the peak discharge and flood hydrograph using analog computers are described. The value of lag between peaks of rainfall and runoff and the coefficient of the shape of flood expressed as ratio between the duration of fall and rise limbs of the hydrograph are used as principal parameters. The time of travel may be considered either constant during flood (linear model) or changing in accordance with the area, slope and the shape of the basin, percentage of forest area, and other physiographic and morphometric characteristics. (Knapp-USGS)
W69-07955

UTILIZATION OF THE ANALOG COMPUTER FOR SIMULATING THE SALINITY FLOW SYSTEM OF THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
M. Leon Hyatt, J. Paul Riley, and Eugene K. Israelsen.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 101-111, 1968. 11 p, 4 fig.

Descriptors: *Analog computers, *Streamflow, *Water quality, *Colorado River, *Utah, Saline water, Model studies, Water management (Applied), Hydrologic budget, Streamflow forecasting, River forecasting, Economics.
Identifiers: Water quality variations, Salt load (Rivers), Upper Colorado River.

Changes in the hydrologic equilibrium of a river basin resulting from resource development bring about changes in the quality pattern as well. It is important to be able to predict what the resulting quality changes might be from any contemplated development at any specified location within the river system. An electronic analog computer was used for simulating the water and salt flows of the Upper Colorado River basin. To calculate the relationship between salt flow and water flow, a hydrologic model is based on historical water budgeting utilizing almost all available data of water flows, municipal and industrial uses, and the demands from agriculture. Where data or records are not available the trial and error capabilities of the analog, one of the most vital assets of the analog because of the ease and quickness in producing a solution, were utilized to obtain the most reasonable estimate of the lacking variable. The salt flow is added to the water flow system utilizing historic measurements of salt concentration. The salt concentration is characterized by a volume flow of salt coupled with the volume flow of water. Because of the integration capability of the analog computer the solutions obtained are on a continuous basis. Such information might be used in allocating the cost of damages to the pollutor resulting from the increase of salinity. The economics of water pollution could thus be evaluated at any point in the Upper Colorado River basin. (Knapp-USGS)
W69-07957

DIGITAL COMPUTER SOLUTIONS FOR FLOOD HYDROGRAPH PREDICTION FROM RAINFALL DATA,
Technische Hochschule, Munich (West Germany). Hydraulics Research Station Obernach.
For primary bibliographic entry see Field 02A.
W69-07958

DETERMINATION OF THE RUNOFF HYDROGRAPH ON A DETERMINISTIC BASIS USING A DIGITAL COMPUTER,
Technical Univ. of Budapest (Hungary).
For primary bibliographic entry see Field 02A.
W69-07959

FLOOD PLAIN INFORMATION, CHICKAHOMINY RIVER WEST OF BOTTOMS BRIDGE, HENRICO COUNTY, VIRGINIA.
Corps of Engineers, Norfolk, Va.
For primary bibliographic entry see Field 04A.
W69-07961

FLOOD PLAIN INFORMATION, NEW RIVER, CHANEY, MILL, AND BLUE CREEKS, JACKSONVILLE, NORTH CAROLINA.
Corps of Engineers, Wilmington, N. C.
For primary bibliographic entry see Field 04A.
W69-07962

FLOOD PLAIN INFORMATION OF MUD RIVER IN VICINITY OF MILTON, WEST VIRGINIA.
Corps of Engineers, Huntington, W. Va.
For primary bibliographic entry see Field 04A.
W69-07963

FLOOD PLAIN INFORMATION REPORT ON DELAWARE RIVER, BUCKS COUNTY, PENNSYLVANIA.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W69-07975

HYDROLOGIC REGIONS IN BULGARIA (BULGARIAN),
Iv Marinov, and T. Panajotov.
Hidrologija i meteorologija, Vol 16, no 6, pp 41-51, 1967. 11 p, 4 fig, 4 ref.

Descriptors: *Hydrologic aspects, *Climatic zones, *River basins, Precipitation (Atmospheric), Runoff, Snowmelt, Surface-groundwater relationships, Low flow.
Identifiers: *Bulgaria, Hydrologic regions, Mesta River, Struma River, Black Sea.

Regularities in precipitation and runoff permit division of Bulgaria into two regions: one influenced by the European continental climate, and the other by the continental and Mediterranean climate. Almost all of north Bulgaria and the western half of south Bulgaria comprise the first region where about 65% of the runoff occurs in the Feb-June period. In the second region, comprising the eastern half of south Bulgaria, a narrow strip of the northern Black Sea coast and parts of the Struma and Mesta River valleys, 65% of the annual runoff is in the Nov-Mar period. Three kinds of inflow are described: snowmelt and rainfall, snow, and rainfall; phases of the runoff are an index also, as is subterranean feeding. The river basins can be put into three groups: those with stable runoff, moderately stable and unstable runoff. (Gabriel-USGS)
W69-07979

A PROBLEM ON THE EFFECT OF KARST ON THE HYDROLOGIC REGIME OF RIVERS,
A. M. Gavrilov.
Hydrol of Fractured Rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 544-562, 1967. 19 p, 9 fig, 22 tab.

Descriptors: *Karst, *Hydrologic cycle, *Hydrologic properties, *River flow, *Rivers, Fissures (Geology), Runoff, Discharge, Basins, Permeability, Water storage, Hydraulic structures, Precipitation, Hydrograph analysis, Gaging stations, Streamflow, Analog models, Water resources.
Identifiers: *European USSR, Volga River, Orodezh basin, Belomorsko-Kuloiskoye plateau, Onega-Severnaya Dvina.

The karstic effects upon the runoff of small rivers within the northern and central zones of the European part of the USSR were investigated on the basis of some detailed field work and permanent stream gaging station data observed during several years. The study shows that the application of the analogy method for hydrologic designs and, in particular, the use of ordinary small-scale maps of runoff should be strictly limited to indisputable cases of proven natural similarity. Schematic maps should be drawn of summer and winter runoffs associated with the approximate evaluation of water resources. It is recommended also to establish a relationship between streamflow and the level of underground waters feeding the rivers. The article discusses karstic influence on surface water in the following areas: (1) runoff in the Oredezh river basin; (2) streamflow in the Belomorsk-Kuloysk plateau; (3) streamflow in the Onaga-Dvina area; and (4) streamflow in the middle Volga region. (Gabriel-USGS)
W69-07982

STAGES AND DISCHARGES OF THE MISSISSIPPI RIVER AND TRIBUTARIES IN THE ST. LOUIS DISTRICT, 1965.
Corps of Engineers, St. Louis, Mo.
For primary bibliographic entry see Field 04A.
W69-07988

THE INFLUENCE OF AQUATIC VEGETATION ON RIVER DISCHARGE,
State Inst. of Hydrology and Meteorology, Warsaw (Poland).
For primary bibliographic entry see Field 04A.
W69-07989

SPATIAL VARIATION OF FLOOD FREQUENCIES AS RELATED TO HYDRAULIC GEOMETRY,
Georgia Univ., Athens. Dept. of Geography.
Richard A. Stephenson.
Southeastern Geol, Vol 10, No 3, pp 165-174, July 1969. 10 p, 1 fig, 4 tab, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Flood forecasting, *Runoff forecasting, *Channel morphology, Statistical methods, Floods, Streamflow, Regression analysis, Flood routing.
Identifiers: Hydraulic geometry, Flood frequencies.

Hydraulic geometry is, in essence, the description of channel characteristics and their relationship to streamflow. The relationships of flood frequencies

to hydraulic parameters are describedc, in theory and in numerous studies. From standardized residuals from regression, a significant variation was found in sample basins in the southern Blue Ridge Mountains. Also, it was found that the relationship between flood frequencies and hydraulic parameters is rather weak. (Knapp-USGS)
W69-07991

CHANNEL CAPACITY AND THE ADJUSTMENT OF STREAMS TO HYDROLOGIC REGIME,
Liverpool Univ. (England). Dept. of Geography.
A. M. Harvey.
J Hydrol, Vol 8, No 1, pp 82-98, May 1969. 17 p, 7 fig, 1 tab, 21 ref.

Descriptors: *Streamflow, *Alluvial channels, *Channel morphology, *Stage-discharge relations, Flow characteristics, Duration curves, Depth-area-duration analysis.
Identifiers: Flood recurrence intervals, Flood frequency.

Previous work on the frequency of bankfull discharge on alluvial streams in a variety of environments suggests a recurrence interval for bankfull conditions of somewhere between 1 and 3 yr. In 3 streams in southern England chosen for study, seventy-one cross sections were surveyed in the field and their discharge capacities determined. Variations in the frequency of bankfull were found both between the streams and along each stream. Flood regime stream-segments appear to exhibit adjustment to the 1-2 yr flood but with less frequent flooding downstream. Baseflow streams appear to be adjusted to rarer floods and the Wallop Brook exhibits an increase in flood frequency downstream. Two factors are suggested to explain these differences; the frequency of competent discharges and the duration of floods of a given frequency. The channels are seen to represent a balance between erosion and deposition influenced by the magnitude, frequency and duration of high discharges, but those of the baseflow streams appear to be more susceptible to short term changes by aggradation in response to subtle environmental variations. (Knapp-USGS)
W69-08006

ULTRASONIC FLOWMETERS FOR MEASURING RIVER TURBULENCE,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
For primary bibliographic entry see Field 07B.
W69-08017

FLOW DIVIDERS FOR THE MIDDLE DURANCE (FRENCH),
B.V.S. Co. (France). Research Dept.
For primary bibliographic entry see Field 08C.
W69-08021

BASIC DATA FOR URBAN HYDROLOGY STUDY, DALLAS, TEXAS--1966,
Geological Survey, Austin, Tex.
Trigg Twitchell.
Geol Surv Open-file Rep, 1966. 203 p, 3 fig, 1 tab.

Descriptors: *Rainfall-runoff relationships, *Urbanization, *Data collections, *Texas, Streamflow, Runoff, Hydrographs, Rainfall, Surface waters, Hydrologic data, Mass curves, Depth-area, Duration analysis.
Identifiers: Dallas (Tex), Urban hydrology.

Basic hydrologic data compiled for the study of urban hydrology in Dallas, Texas include data from raingages, stream gages, and flood-profile partial-record stations. Hydrographs and mass curves are given for major storms at each station. (Knapp-USGS)
W69-08056

2F. Groundwater

THEORY OF INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 02G.
W69-07727

GEOLOGY FOR LAND AND GROUND-WATER DEVELOPMENT IN WAYNE COUNTY, MICHIGAN,
Wayne State Univ., Detroit, Mich.
Andrew J. Mazola.
Mich State Geol Surv Rep Invest No 3, 1969. 25 p, 9 fig, 4 plate, 1 map, 1 chart, 41 ref.

Descriptors: *Geology, *Hydrogeology, *Groundwater, *Michigan, Permeability, Glacial drift, Aquifers, Sands, Clays, Groundwater movement.
Identifiers: Wayne County (Mich), Detroit.

The subsurface geology of Wayne County, Michigan is discussed in a report intended for use by planning agencies. Map show bedrock geology, bedrock topography, glacial drift thickness, and glacial geology. Because water becomes involved directly or indirectly with many projects, this report briefly describes the bedrock and glacial deposits that are present beneath the county and the occurrence of groundwater in such materials. A small scale bedrock map of the state and a Michigan Stratigraphic Nomenclature Chart are also included to show the relationship of the geology of Wayne County to the rest of the state. (Knapp-USGS)
W69-07728

CHEMICAL PROPERTIES OF GROUND WATER AND THEIR CORROSION AND ENCRUSTATION EFFECTS ON WELLS,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02K.
W69-07729

GROUND-WATER RESOURCES OF THE WIND RIVER INDIAN RESERVATION, WYOMING,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 03B.
W69-07731

APPLICATION OF ANALOGUE COMPUTERS FOR PREDICTING THE GROUND WATER REGIME OF ARTESIAN BASINS UNDER CONDITIONS OF THEIR DEVELOPMENT,
All-Union Research Inst. of Water Supply, Drainage, Hydro-Engineering Works and Engineering Hydrogeology, Moscow (USSR).
I. I. Krashin, and D. I. Peresunjko.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 59-66, 1968. 8 p, 4 fig, 2 ref.

Descriptors: *Analog models, *Water-level fluctuations, *Groundwater basins, Artesian wells, Aquifers, Resistance networks, Forecasting, Water management (Applied), Discharge (Water), Recharge, Pumping.
Identifiers: USSR, Moscow Basin (USSR).

The application of electrical network models for a long-term prediction of the dynamics of falling groundwater heads as a result of intensive development in the central part of the Moscow artesian basin is discussed. The optimum regime of water sampling, the prospective areas for additional water sampling and the most appropriate pattern distribution of new water supply wells were calculated. To take into account the natural hydrogeological conditions of a great territory, use may be made of an electronic analogue computer. The pattern of an electrical model of the studied region of the basin has been improved by solving a series of reverse problems under the stationary and non-stationary conditions. The natural and artificial factors, which determine the nature and rate of groundwater declines in the period of observation in the basin, were reproduced. To solve the reverse problems and make predictions, a single-layered and a multi-layered pattern were modeled. (Knapp-USGS)
W69-07746

FORECASTING THE RISE OF GROUNDWATERS IN THE AREA OF THE RIVER VAKHSH FOURTH TERRACE (RUSSIAN),
Akademiya Nauk Tadzhikskoi SSR, Dushanbe. Institut Pochvovedeniia.
E. G. Vaksman.
Dokl Akad Nauk, Tadzh SSR, Vol 11, No 10, pp 57-60, 1968. 4 p, 1 fig, 3 ref.

Descriptors: *Forecasting, *Aquifers, *Groundwater movement, *Mathematical studies, Saline soils, Geology, Gravels, Infiltration, Hydrogeology, Pressure, Water balance, Water levels, Hydrogeologic properties.
Identifiers: Groundwater behavior forecasting.

The possibility of forecasting the groundwater levels under the hydrogeological conditions present in the Kolkhozabad district was analytically investigated by using an equation of water balance and a differential equation of the fourth order. By calculating the constants of integration and substituting them into the solution of the fourth order equation, an equation characterizing the level of groundwaters of the fourth terrace was obtained. The study shows that the equation characterizing the groundwater levels takes into consideration a large number (over ten) of natural and economic factors and gives a good approximation of groundwater levels present at any given period. (Gabriel-USGS)
W69-07750

EXPLOITATION OF GROUNDWATER AND HYDROLOGIC BALANCE OF THE CALCAREOUS MASSIFS OF TUNISIA (FRENCH),
Gilbert Castany.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 518-525, 1967. 8 p, 11 tab.

Descriptors: *Exploitation, *Groundwater, *Water balance, *Hydrologic properties, *Limestones, Precipitation, Aquifers, Water sources, Evapotranspiration, Water balance, Water wells, Pumping, Runoff, Hydrogeology, Infiltration.
Identifiers: *Tunisia, Calcareous massifs.

The supply of groundwater in the calcareous massifs of Tunisia was investigated on the basis of earlier geological and hydrologic studies conducted by T. Tixeront and E. Berkaloff, and H. Zebidi. The article gives an estimate of the water balance worked out by Tixeront and Berkaloff based on the determination of rain intensity, extraction volumes, and water reserves from spring discharges. Application of the more general method based on the calculation of evapotranspiration, surface runoff, and infiltration is also given. The general method was used by Zebidi for the evaluation of water balance of Bargou. (Gabriel-USGS)
W69-07766

GROUND WATER IN ONTONAGON COUNTY, MICHIGAN,
Geological Survey, Lansing, Mich.
C. J. Doonan, and G. E. Hendrickson.
Mich State Geol Surv Water Invest Rep No 9, May 1969. 29 p, 5 fig, 1 plate, 4 ref.

Descriptors: *Water resources, *Groundwater, *Michigan, Water wells, Hydrologic data, Data collections, Water quality, Aquifers, Water levels, Water yield.
Identifiers: Ontonagon County (Mich).

Most wells in Ontonagon County, Michigan obtain water from glacial lake beds or from bedrock. Deposits of glacial till and outwash also yield water to domestic wells in a few parts of the county. The lake beds supply enough water for domestic use to many wells, but more than half of the wells in the county are drilled into bedrock to obtain a satisfactory supply. Wells yielding large supplies of several hundred gallons per minute are unknown in this county. Water from most wells is hard to very hard, and many wells yield water that contains objectionable amounts of iron. Water from the deeper wells in bedrock, especially near Lake Superior, is generally too salty for domestic use. (Knapp-USGS)
W69-07926

HYDROLOGIC DATA: 1967, VOLUME 5: SOUTHERN CALIFORNIA,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 02E.
W69-07933

ELECTROLYTIC TANK TYPE MODELS FOR PREDICTING THE POSITION OF THE GROUNDWATER TABLE AND THE LOSS OF RIVER DISCHARGES,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02A.
W69-07949

ELECTRICAL-ANALOG ANALYSIS OF THE HYDROLOGIC SYSTEM IN TUCSON BASIN, ARIZONA, U.S.A.,
Geological Survey, Tucson, Ariz.
T. W. Anderson.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 15-24, 1968. 10 p, 5 fig.

Descriptors: *Model studies, *Analog models, *Groundwater basins, *Arizona, Water levels, Water-level fluctuations, Pumping, Water wells, Aquifers, Forecasting, Water demand, Planning, Water yield, Recharge.
Identifiers: Tucson Basin (Ariz).

The water supply for the area in the Tucson basin, Arizona, is derived entirely from groundwater, and pumpage has caused water-level declines of as much as 60 ft. An electrical-analog model of the hydrologic system in the Tucson basin area was constructed to provide a hydrologic tool for determining the effects of possible groundwater management schemes. Periodic water-level data, pumpage, and transmissibility constants were compiled to allow the construction of the primary model. Preliminary analyses of the model showed where additional data or modifications in model design were needed. The final design, the most precise representation of the actual data was used to predict groundwater levels in 1985, assuming that pumpage is stabilized at the present rate and distribution. (Knapp-USGS)
W69-07950

NEW APPROACH SUGGESTED FOR DESIGN OF ELECTRICAL ANALOG COMPUTERS FOR GROUNDWATER FLOW STUDIES,
Tata Inst. of Fundamental Research, Bombay (India).
P. Kumaraswamy.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 95-100, 1968. 6 p, 9 ref.

Descriptors: *Analog models, *Aquifers, *Groundwater movement, Pumping, Water wells, Water levels, Water level fluctuations, Water management (Applied).
Identifiers: India.

The usual electrical analog computer used for groundwater studies consists of an analog model simulating the aquifer by an array of discrete resistors and capacitors representing a scaled version of the hydraulic resistance and storage properties. Invariably it is economically impossible to gather sufficient field data to truly assess the aquifer characteristics and hence to build a true analog. To obviate the above difficulty, a new approach of design of the computing device is suggested. Only pumping rates and water levels and the history of their variations in space and time as well as the depths and locations of all wells are used. A liquid medium (continuous resistance in lieu of discrete resistors) should be selected and wells will be simulated by conducting rods of suitable dimensions and penetrations into the electrolyte. By utilizing suitable servos, all the observed potential changes and current changes in the analog will simulate synchronously the water level and flow changes in the aquifer. Such a computer will simulate the aquifer at every moment, as and when the excitation-response pairs are transduced into electrical quantities and telemetrically injected into the analog. (Knapp-USGS)
W69-07956

SIMULTANEOUS FLOW OF WATER AND HEAT UNDER PERIODIC HEAT FLUCTUATIONS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agricultural Research.
For primary bibliographic entry see Field 02G.
W69-07964

MINERAL WATERS OF THE BURGAS (BULGARIA) ARTESIAN BASIN AND THEIR HEALTH RESORT AND ECONOMIC SIGNIFICANCE (BULGARIAN),
K. Sterev, and T. Kehajov.
Nauc. tr. NII kurortologija i fizioterapija, Vol 9, pp 37-44, 1968. 8 p, 2 fig, 2 tab, 5 ref.

Descriptors: *Mineral water, *Artesian wells, *Aquifers, *Spring waters, Economics, Geology, Thermal water, Sedimentary rocks, Igneous rocks, Industrial waters, Carbon dioxide.
Identifiers: *Bulgaria, Mineralized springs, Health resorts.

The possibility of finding deep overheated waters in the Burgas anticlinorium was investigated by examining water-bearing complexes of Pre-Senonian formations. The study shows that these complexes, overlain by a thick volcano-sedimentary series, contain overheated waters carrying in some places a high content of carbon dioxide. It is estimated that the producing horizons of overheated waters would be reached at a depth of 1000 m or more. (Gabriel-USGS)
W69-07970

HARDNESS OF GROUND WATERS IN BULGARIA (BULGARIAN),
Toso M. Kehajov.
In Jubileen geologiceski sbornik (Anniversary geological collection), Sofia, Bulgavskaya Akademiya Nauk, pp 447-455, 1968. 10 p, 4 fig, 5 tab, 9 ref.

Descriptors: *Aquifers, *Hardness (Water), *Water chemistry, Chemical analysis, Calcium, Carbonates, Mountains, Manganese, Chlorides, Sulfates, Mapping.
Identifiers: *Bulgaria.

Mineral characteristics of Bulgarian groundwaters are examined using earlier publications and recent studies by the author. The average water mineralization ranges from 0.2 to 1.2 g/l. Low mineralized hydrocarbonate-calcium waters are associated with the high mountain areas and waters of higher mineral content are found in the plains and coastal areas. Groundwater in the plains and coastal areas is of the calcium-magnesium and sulphate-chloride type. A map is presented giving the distribution of groundwaters in Bulgaria based upon the following criteria: very soft (Ca and Mg less than 1.5 mg eq), soft (1.5-3.0 mg eq), medium hard (3.0-4.5 mg eq), fairly hard (4.5-6.0 mg eq), hard (6.0-9.0 mg eq), and very hard (greater than 9 mg eq). (Gabriel-USGS)
W69-07971

DETERMINATION OF HYDROGEOLOGICAL PARAMETERS BY PUMPING TESTS IN WATER TABLE AQUIFER (BULGARIAN),
Il. G. Jotov.
In Jubileen geologiceski sbornik, (Anniversary Geological Collection), Sofia, Bulgavskaya Akademiya Nauk, pp 457-465, 1968. 9 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Hydrologic properties, *Aquifers, *Water table, *Pumping, Theis equation, Mathematical studies, Parametric hydrology, Wells, Hydraulics, Analytical techniques.
Identifiers: *Hydrogeological parameters, Pumping tests.

An analytical method is developed for determination of the formation characteristics in unconfined aquifers (water table conditions). The analysis is made on the basis of solving flow equations in which specific yield is variable in time (Boutlon's equation). Data are recorded at two observation wells and parameters are evaluated by using the Theis method. Comparison is made between drawdowns obtained at variable and at constant specific yields. It is concluded that the method used reduces considerably the duration of pumping tests. A numerical example is given to illustrate the method. (Gabriel-USGS)
W69-07972

CONFINED FRESH WATER AQUIFERS IN LIMESTONE EXPLOITED IN NORTH MEXICO WITH DEEP WELLS BELOW SEA LEVEL,
Office of Hydraulic Resources (Mexico).
Heinz Lesser Jones.
Hydrol of Fractured Rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 526-539, 1967. 14 p, 9 fig.

Descriptors: *Groundwater, *Hydrologic properties, *Limestones, Water wells, Geologic control, Water yield, Artesian wells, Transmissivity, Drawdown, Sea level, Mesozoic era, Groundwater recharge, Storage capacity, Rainfall, Geomorphology, Pleistocene epoch, Geophysics, Electrical well logging.
Identifiers: *Mexico, Eastern Sierra Madre Range.

Fresh water aquifers in limestone formations of the Eastern Sierra Madre, Mexico, are described on the basis of geological, hydrological, and electrical well-logging data. The limestones are very persistent and pervious, of total thickness of about 1,000 m, and contain in some areas aquifers of considerable productivity. Several cities in northern Mexico obtain their water supply from the limestones. About 50 wells of depths varying from 200 to 1,400 m and elevations varying from 1 to 800 m below sea level have been developed by these cities. The confined limestone aquifers are under artesian pressure. Well yields of 40 to 240 liters per second and drawdown of 2 to 40 m have been recorded. Water levels vary from 20 to 80 m seasonally. Transmissibilities and storage capacities are extremely high. Recharge from the isolated rains that occur within the aquifer outcrops is nearly instantaneous. (Gabriel-USGS)
W69-07981

PROBLEMS OF STORAGE DAM CONSTRUCTION IN EASTERN HERZEGOVINA (FRENCH),
For primary bibliographic entry see Field 08A.
W69-07984

CARBONATE EQUILIBRIA AND RADIOCARBON DISTRIBUTION RELATED TO GROUND-

WATER FLOW IN THE FLORIDAN LIMESTONE AQUIFER, USA,
Geological Survey, Washington, D. C.
Bruce B. Hanshaw, William Back, and Meyer Rubin.
Hydrol of Fractured Rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 601-614, 1967. 14 p, 8 fig, 2 tab, 10 ref.

Descriptors: *Groundwater movement, *Aquifers, *Limestones, *Chemical reactions, *Florida, Equilibrium, Carbon, Dolomite, Radioactivity, Radioactive dating, Sulfates, Calcium carbonate, Water properties, Water quality, Groundwater recharge, Groundwater, Tertiary, Geology, Hydrogeology, Magnesium.

The application of geochemical principles to a reasonably well known hydrologic environment is applied for determining the solid phases which control the chemistry of water moving through an aquifer system. Major recharge to the Floridan aquifer, consisting of a series of limestones of Tertiary age and some dolomite, occurs in both high and low areas of the piezometric surface. Principal areas of recharge in the aquifer are marked by low total dissolved solids, low sulfate and magnesium content, and high C-14 concentrations (low apparent ages). Because C-14 concentration decreases in a systematic manner, apparent groundwater velocities may be reliably calculated. The article contains among others, the following topics: chemical character of the water: radiocarbon concentrations; and mineral equilibrium. (Gabriel-USGS)
W69-07985

UNCONFINED AQUIFERS AND THE CONCEPT OF THE SPECIFIC YIELD,
Agricultural Research Council, Cambridge (England). Unit of Soil Physics.
E. G. Youngs.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 191-197, June 1969. 7 p, 2 fig, 9 ref.

Descriptors: *Specific yield, *Aquifers, Groundwater movement, Infiltration, Permeability, Drainage, Porosity, Specific retention, Water storage, Percolation.
Identifiers: Groundwater flow equations.

The concept of the specific yield as it is applied to unconfined aquifers is discussed, and it is shown that the value of the true specific yield is generally a function of both horizontal position and time. Because of the difficulties associated with the measurement of local fluxes and local water-table movements necessary to obtain values of the true specific yield, the average, the bulk and the virtual specific yields are defined, all of which are time dependent and the last 2 of which require the measurement of average fluxes over the catchment area. The non-constancy of the specific yield is illustrated in experimental results obtained with intermittent rainfall over a drainage installation where negative values were obtained, and reached infinite positive and negative values at maximum and minimum water-table heights. (Knapp-USGS)
W69-08000

TRANSIENT FLOWS IN AQUIFERS WITH FREE WATER SURFACES, TAKING INTO ACCOUNT THE UNSATURATED ZONE: CRITIQUE OF CLASSIC ANALOG MODELS (FRENCH),
Grenoble Univ. (France). Laboratoires de Mecanique des Fluides.
G. Vachaud, and J. L. Thony.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 199-215, June 1969. 16 p, 5 fig, 1 tab, 22 ref.

Descriptors: *Groundwater movement, *Equations, *Mathematical models, Permeability, Aquifers, Saturated flow, Unsaturated flow, Drainage, Evaporation, Recharge, Hydraulic conductivity, Hydraulic models.
Identifiers: Boussinesq equation.

An attempt was made to consider as a whole the flow of water in both saturated and unsaturated zones. The position of the water table, when considering the hydrodynamics of free surface aquifers, must be controlled by the flow occurring in the unsaturated zone. A system of 2 differential equations, each one related to the saturated and unsaturated zone, is proposed for defining the position of the water table. This replaces the unique classical BOUSSINESQ equation, which is obtained by considering the free surface as the upper boundary of the flow domain. In view of experimental results obtained from the drainage of vertical soil columns, a critique of classical analog models is made. A two-dimensional soil hydraulic model is proposed for obtaining a complete description of the variation of water-content, water fluxes and pressure during unsteady conditions of drainage and recharge. Measurements of changes of water content and pressure may be obtained during unsteady conditions of drainage and recharge by a series of 3 Am-241 sources of gamma-rays and 20 tensiometers and pressure transducers connected to a data-logging system and computer. (Knapp-USGS)
W69-08001

GROUNDWATER STUDIES IN THE SABI VALLEY, RHODESIA, USING NATURAL TRITIUM MEASUREMENTS,
Agricultural Research Council of Central Africa. Hydrology Research Team.
P. Wurzel, and P. R. B. Ward.
J Hydrol, Vol 8, No 1, pp 48-58, May 1969. 11 p, 2 fig, 1 tab, 10 ref.

Descriptors: *Groundwater movement, *Tracers, *Tritium, Base flow, Laboratory tests, Electrolysis, Radio-chemical analysis, Surface-groundwater relationships.
Identifiers: *Sabi Valley (Rhodesia).

Environmental tritium was used as a groundwater tracer in the Sabi Valley Alluvial plain in Rhodesia, and flow data was obtained on a regional scale. It is shown that its groundwater movement is closely approximated by direct flow and the tritium content in boreholes is related to tritium input in 2 areas of recharge. The preliminary results indicate that the Sabi River is playing a greater part in the groundwater regime of the alluvial plain than originally anticipated. Velocity of movement of the groundwater is deduced as 2-5 ft/day. The low level tritium counting system used in the authors' laboratory is briefly described, and the limit and accuracy of measurement is discussed. (Knapp-USGS)
W69-08004

A STUDY OF THE SPECIFIC YIELD IN LAND-DRAINAGE SITUATIONS,
Agricultural Research Council, Cambridge (England). Unit of Soil Physics.
For primary bibliographic entry see Field 04A.
W69-08005

THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
Imperial Coll. of Science and Technology, London (England). Dept. of Geology.
For primary bibliographic entry see Field 4B.
W69-08009

EFFECT OF NEOTECTONICS ON THE FORMATION CONDITIONS OF GROUND WATERS OF THE EASTERN PART OF THE CHU BASIN (RUSSIAN),
Chu Hydrogeological Expedition.
Yu. P. Kopotilov.
Razved i Okhrana, No 3, pp 46-48, Mar 1969. 3 p, 1 fig.

Descriptors: *Hydrogeology, *Aquifers, *Structural geology, Boreholes, Mapping, Groundwater basins, Discharge (Water), Discharge measurement, Paleozoic era, Quaternary period, Water storage, Water loss, Water structure, Water levels, Water circulation.
Identifiers: *Chu basin (Cent. Asia).

The effect of neotectonics on the groundwater formation was investigated on the basis of borehole, geological, and hydrological data recorded by the Chu (Central Asia) hydrogeological expedition of 1966-1967. The study shows that the Chu intermontane basin consists of gravel and boulder beds of Quaternary period underlain by the Paleozoic metamorphic rocks. The conditions for the accumulations of groundwaters in the Paleozoic and Quaternary rocks are very dissimilar with specific discharges from boreholes in the Quaternary rocks up to 50 lit/sec, whereas discharges from the Paleozoic formations do not exceed 5-10 lit/sec. The study also shows that the water of the Chu River, after leaving the Boom Canyon, partly infiltrates the soft clastic formations. Hydrologic characteristics of the eastern part of the Chu basin are determined by the neotectonic Paleozoic basement block structure. (Gabriel-USGS)
W69-08016

HYDROGEOLOGIC DATA FROM CHEYENNE, DECATUR, RAWLINS, SHERIDAN, SHEMAN, AND THOMAS COUNTIES, KANSAS,
Kansas State Geological Survey, Lawrence; and Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 07C.
W69-08018

THE MINERAL WATER SPRINGS AT EVIAN (FRENCH),
Department of Sciences, Paris (France). Lab. of Geology Dynamics.
B. Blavoux.
La Houille Blanche, Vol 24, No 1, pp 21-29, 1969. 9 p, 12 fig, 1 tab.

Descriptors: *Spring waters, *Water source, *Mineral water, Hydrologic properties, Geologic mapping, Aquifers, Altitude, Hydrogeology, Precipitation (Atmospheric), Evapotranspiration, Discharge (Water), Runoff, Sedimentation, Glaciers, Water circulation, Water storage, Tritium, Sulfates, Iron, Magnesium, Calcium, Oxygen, Water balance.
Identifiers: *France, Evian area.

This paper, a summary of a doctorate thesis presented at the Faculty of Sciences, Paris, describes the hydrogeological conditions in the Evian area, France. Objective of the work was to determine the origin of the mineral springs and their characteristics and to evaluate the amount of water stored in the Evian aquifer. Surface geological surveys were made and deep boreholes were drilled into the Quaternary fluvio-glacial formations in the Lower Chablaie area. Concurrent climatological and hydrochemical studies were made of the entire catchment area and a groundwater balance was established. It is concluded that the mineral springs have their source in the Quaternary rocks of the Vinzier Plateau. The distribution of dynamic and hydrochemical characteristics at several places in the aquifer are described. (Gabriel-USGS)
W69-08019

MATHEMATICAL SIMULATION OF WATER MOVEMENT THROUGH UNSATURATED NONHOMOGENEOUS SOILS,
Harvard Univ., Cambridge, Mass. Dept. of Water Resources.
For primary bibliographic entry see Field 02G.
W69-08026

GROUNDWATER AQUIFER PATTERNS AND VALLEY ALLUVIATION ALONG MOUNTAIN FORK CREEK, CRAWFORD COUNTY, ARKANSAS,
H. F. Garner.
Arkansas Academy of Science Proceedings, Vol 20, 1966, pp 95-103. 9 p, 4 fig, 5 ref.

Descriptors: *Groundwater, *Aquifer.
Identifiers: *Alluviation, Run-off alluvial thickness, Channel-fill.

The study delineates several alluvium-aquifer relations for Boston Mountain drainage systems. Specifically with regard to Mountain Fork Creek, the bulk of the valley is too thinly alluviated to provide extensive alluvial groundwater along long reaches. Also, many of the thicker alluvial sections are composed of poorly sorted colluvium in the form of small valley-side alluvial fans. Only where these accumulations have been subject to valley-side runoff from springs and tributaries have been fine clastic fractions been flushed away and in some cases such gravels are a potential source of groundwater. It should be emphasized that channel fills of aquifer caliber are close to and essentially parallel to the main stream channel except directly downvalley from sharp bends in the channel or on the concave side of large bends where overflow has affected large portions of the valley flat. Also, in the latter areas alluvial thickness seems greatest, and water-well locations in such sites appear to have the greatest potential.
W69-08118

2G. Water in Soils

THEORY OF SEEPAGE FROM OPEN CHANNELS.
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab,
Herman Bouwer.
Advance in Hydroscience, Vol 5, pp 121-172, 1969. 52 p, 32 fig, 3 tab, 46 ref.

Descriptors: *Seepage, *Soil water movement, *Soil physics, *Model studies, *Research and development, Infiltration, Open channels, Water table, Mathematical models, Analog models, Computer models, Measurement, Hydraulic conductivity, Permeability.
Identifiers: Open-channel seepage, Seepage prediction.

Prediction of seepage from open channels and the measurement of soil hydraulic properties are discussed in a review of current mathematical and field studies in soil water movement. Solutions are available for seepage rates for a great variety of channel, soil, and water table conditions. Most analyses are for steady-state systems, but some transient systems may be handled. Digital and analog computers permit calculation of many boundary conditions. Recent work in soil physics and soil-property measurement makes possible accurate determination of field parameters and realistic model-making. For main entry see W69-07723. (Knapp-USGS)
W69-07725

THEORY OF INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. R. Philip.
Advance in Hydroscience, Vol 5, pp 215-296, 1969. 82 p, 20 fig, 1 tab, 133 ref.

Descriptors: *Infiltration, *Soil water movement, *Groundwater movement, Soil physics, Percolation, Absorption, Mathematical studies, Model studies, Unsaturated flow, Saturated flow, Steady flow, Unsteady flow.
Identifiers: *Infiltration theory.

Recent work in the theory of infiltration is reviewed. The physical basis of the mathematical approach and the limits of its applicability are outlined. A general flow equation is developed, methods for its solution are described, and the physical significance of mathematical solutions is discussed. A bibliography of 133 papers is included. For main entry see W69-07723. (Knapp-USGS)
W69-07727

CLASSIFICATION OF SOILS WITH REFERENCE TO COMPACTION,
Swedish Geotechnical Inst., Stockholm; and Aktiebolaget Vibro-Verken, Solna (Sweden).
For primary bibliographic entry see Field 08D.
W69-07813

IN SITU MEASUREMENT OF THE FREE ENERGY OF SOIL MOISTURE BY SMALL HYGROMETERS (PART 1),
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
For primary bibliographic entry see Field 07B.
W69-07932

SIMULTANEOUS FLOW OF WATER AND HEAT UNDER PERIODIC HEAT FLUCTUATIONS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agricultural Research.
A. Hados.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 297-301, May-June 1968. 5 p, 5 fig, 1 tab, 12 ref, append.

Descriptors: *Heat flow, *Unsaturated flow, *Soil-water movement, *Mathematical models, Mass transfer, Water temperature, Diffusion, Energy transfer, Soil physical properties.
Identifiers: Periodic heat fluctuations, Thermal gradients.

Theoretical predictions of thermally induced moisture transfer have been compared to measured quantities. Soil samples at different initial moisture contents were subjected to sinusoidal heat waves having an amplitude of 6C, and various periods of time. Temperatures were measured at various distances from the heat source, using copper-constantan thermo-couples and recording the emf output. The moisture distribution after the 1st, 2nd, 6th, and 16th cycle was determined gravimetrically. The measured net transfer quantities were found to be larger than the theoretically predicted values by factors ranging from 0.8 to 8.0. The discrepancy between predicted and measured values of net transfer may be attributed to the incompleteness of the theoretical models. (Knapp-USGS)
W69-07964

SELF-DIFFUSION OF TRITIATED WATER IN MONTMORILLONITE AND KAOLINITE CLAY,
Kentucky Univ., Lexington; and Arkansas Univ., Fayetteville.
R. E. Phillips, and D. A. Brown.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 302-306, May-June 1968. 5 p, 4 fig, 1 tab, 16 ref.

Descriptors: *Diffusion, *Clays, *Tritium, *Tracers, Tracking techniques, Soil water movement, Unsaturated flow, Mass transfer, Diffusivity, Radioisotopes.
Identifiers: Self-diffusion, Montmorillonite, Kaolinite.

The quick-freeze technique of measuring diffusion coefficients of ions in clays and soils was adapted to the measurement of self-diffusion coefficients of tritiated water in clays. The self-diffusion coefficients of tritiated water were approximately equal in the kaolinite and montmorillonite clays. The water contents, oven-dry weight basis, used for montmorillonite were 125.0, 118.5, 100.0, and 87.0%; the water contents used for kaolinite were 60.5, 55.0, 43.5, and 39.0%. The calculated average number of water layers on each mineral surface ranged from 3.5 to 5.5 for montmorillonite and from 17 to 26 for kaolinite. The self-diffusion coefficients increased in a linear manner as the average number of water layers present on each mineral surface increased; a slightly different rate of increase was obtained for each of the 2 clays. The lack of difference of the diffusion coefficients in the 2 clays could not be explained on the basis of charge density of the clays nor was a difference in viscosity a plausible explanation. A longer path length of the diffusing water molecules in the kaolinite and a smaller relative mobility of the diffusing water molecules in the montmorillonite is given as a possible explanation. (Knapp-USGS)
W69-07965

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 1. INTERPRETATION OF WATER CONTENT AND PRESSURE PROFILES,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
C. H. M. Van Bavel, G. B. Stirk, and K. J. Brust.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 310-316, May-June 1968. 7 p, 12 fig, 1 tab, 5 ref.

Descriptors: *Soil water movement, *Clay loam, *Irrigation water, *Root zone, Percolation, Unsaturated flow, Soil-water-plant relationships, Water storage, Field capacity, Hydraulic conductivity, Consumptive use, Moisture uptake.
Identifiers: Root extraction (Water).

The distribution of irrigation water in an Adelanto clay loam profile was studied in a field plot by simultaneous, periodic observations of the water content and hydraulic head profiles. Successive measurement series were made with the plot bare and covered, bare, and planted to a sorghum crop. From the first two, the in situ and dynamic relations of water content to water pressure and to conductivity were obtained. From the cropped field data, the root-extraction pattern was derived, using the established hydraulic properties of the profile. The data demonstrate the variability within depths and locations of water retention and conduction properties and the consequent problem of calculating fluxes. The mobile character of soil water is also evident, confirming the inadequacy of static concepts of soil water 'constants' for a profile. Calculated root-extraction rates agreed reasonably with independent lysimetric measurements of the water loss from the surface to the atmosphere. (Knapp-USGS)
W69-07966

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 2. THE WATER BALANCE OF THE ROOT ZONE,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
C. M. H. Van Bavel, K. J. Brust, and G. B. Stirk.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 317-321, May-June 1968. 5 p, 7 fig, 1 tab, 14 ref.

Descriptors: *Water balance, *Root zone, *Soil water movement, Lysimeters, Irrigation water, Clay loam, Percolation, Unsaturated flow, Soil-water-plant relationships, Water storage, Hydraulic conductivity, Hydraulic gradient, Consumptive use, Evapotranspiration, Moisture uptake.
Identifiers: Root extraction (Water).

Soil water depletion rates in a 115-cm and a 170-cm deep profile of Adelanto clay loam were compared with lysimetrically obtained consumptive use rates for periods of many days after measured water applications. When the soil was bare, the depletion rates were always higher than the rate of loss to the atmosphere, and the inferred flux at the 170-cm depth was as high as 2 mm/day 8 days after irrigation. When the test plot was planted to sorghum an initially strong downward flux at the 170-cm depth reversed itself after about 10 days and became as high as 4 mm/day, representing upward flow of water from wet soil into the root zone above. The data imply that indiscriminate use of soil water depletion rates as representing consumptive use rates can be highly misleading at any time in an irrigation cycle. Further analysis shows that rational and satisfactory correction of depletion data is not likely feasible, and, at any rate, unworkable for the condition of the experiment. (Knapp-USGS)
W69-07967

COUPLING PHENOMENA AS A POSSIBLE CAUSE OF 'NON-DARCIAN' BEHAVIOUR OF WATER IN SOIL,
Agricultural Univ., Wageningen (Netherlands). Lab. of Soils and Fertilizers.
G. H. Bolt, and P. H. Groenevelt.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 17-28, June 1969. 12 p, 4 fig, 2 tab, 15 ref.

Descriptors: *Soil water movement, *Groundwater movement, Flow, Porous media, Darcy's law, Hydraulic gradient, Osmotic pressure, Convection, Ion transport, Diffusion.
Identifiers: Non-Darcian flow, Flow mechanism coupling.

The 'non-Darcian' behavior of water in soils may be caused by the coupling that can occur between the different transport phenomena. It is predicted that a difference in osmotic pressure will arise when solutions flow through porous media, and that due to that difference the resulting flow is related in a non-linear fashion to the applied pressure difference. Several numerical examples are presented. (Knapp-USGS)
W69-07993

UNSATURATED POROUS MEDIA AND THE THEORY OF MIXTURES (FRENCH),
Grenoble Univ. (France). Laboratoires de Mecanique des Fluides.
P. Guelin.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 29-47, June 1969. 19 p, 36 ref.

Descriptors: *Unsaturated flow, *Porous media, *Hysteresis, *Mathematical models, Soil water movement, Groundwater movement, Diffusion, Osmosis, Thermodynamics, Hydraulic gradient, Osmotic pressure.
Identifiers: Ficks law.

The behavior of unsaturated porous materials is described in terms of Fick's mixture theory. Hysteresis is included by use of the Volterra's integral form or by an approximative method using experimental results. Several mathematical models corresponding to physically significant situations are derived from the theory. (Knapp-USGS)
W69-07994

DISPERSION AND REACTION IN UNSATURATED SOILS APPLICATIONS TO TRACERS,
Grenoble Univ. (France). Laboratoires de Mecanique des Fluides.
D. E. Elrick.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 49-60, June 1969. 12 p, 24 ref.

Descriptors: *Soil water movement, *Unsaturated flow, *Tracers, Dye releases, Radioisotopes, Stable isotopes, Salts, Tracking techniques, Diffusion, Adsorption, Dispersion, Ion transport, Reviews.
Identifiers: Soil water movement tracers.

The commonly used soil moisture and groundwater tracers include dyes such as fluorescein, pyramine and non-fluorescent dyes; anions such as chloride and nitrate; radioactive isotopes either as cation complexes or in anionic forms, and tagged water molecules. In several studies soil moisture movements were measured by isotope tagging. It is worth noting that this method can be employed to determine groundwater recharge. The soil moisture zone is probably the most difficult realm of the environment in which to obtain acceptable tracer behavior. For example, comparisons of tritium and chloride movement in neutral to basic soils from arid regions suggest that chloride ions move at an equal or slightly faster rate than tritium. It has been assumed that chloride ions are repelled from the negatively charged soil particles into the central region of the pores where the water velocity is greatest and that tritiated water exchanges with water adsorbed on the soil particles, thus retarding the tritium movement. Both laboratory and field experiments indicated considerable retardation of the chloride relative to the tritium movement. Thus, the performance of any tracer being considered for soil moisture studies should be tested in the specific soil under investigation. (Knapp-USGS)
W69-07995

CONSIDERATIONS ON THE INFLUENCE OF A GASEOUS ENTRAPMENT PHASE IN POROUS MEDIA (FRENCH),
Louvain Univ. (Belgium). Dept. of Scientific Agronomy.
L. W. De Backer.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 61-66, June 1969. 6 p, 2 fig, 14 ref.

Descriptors: *Unsaturated flow, *Porous media, Transmissivity, Diffusion, Solubility, Diffusivity, Hydraulic conductivity, Hysteresis.
Identifiers: *Gas entrapment.

In porous media, entrapped gas is considered as an important factor reducing the transmissibility of fluid. Because entrapment mechanisms are poorly known and entrapped gas content is a function not only of water content but also of time due to the gas solubility, experimental results do not match satisfactorily with the diffusivity or continuum mechanics theories which do not take the entrapped gas phase into account. Measurements of entrapped gas content are presented together with the corresponding water content hysteresis isotherm. (Knapp-USGS)
W69-07996

WATER CONTENT MEASUREMENT WITH^{60} keV GAMMA RAY ATTENUATION,
Agricultural Univ., Wageningen (Netherlands); and Technical Univ. of Prague (Czechoslovakia).
For primary bibliographic entry see Field 07B.
W69-07997

SOME CONSIDERATIONS ON THE EMPLOYMENT OF TENSIOMETERS (FRENCH),
Toulouse Univ. (France). Institut de Mecanique des Fluides.
For primary bibliographic entry see Field 07B.
W69-07998

A MATHEMATICAL FUNCTION FOR DESCRIBING CAPILLARY PRESSURE-DESATURATION DATA,
Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 07B.
W69-07999

TRANSIENT FLOWS IN AQUIFERS WITH FREE WATER SURFACES, TAKING INTO ACCOUNT THE UNSATURATED ZONE: CRITIQUE OF CLASSIC ANALOG MODELS (FRENCH),
Grenoble Univ. (France). Laboratoires de Mecanique des Fluides.
For primary bibliographic entry see Field 02F.
W69-08001

ILLUSTRATIONS OF SOIL MOISTURE VARIABILITY IN SELECTED AREAS AND PLOTS OF DIFFERENT SIZES,
R. C. Hills, and S. G. Reynolds.
J Hydrol, Vol 8, No 1, pp 27-47, May 1969. 21 p, 10 fig, 21 ref.

Descriptors: *Sampling, *Soil moisture, *Variability, *Statistical methods, Probability, Fluctuation, Heterogeneity, Homogeneity, Soil surveys, Soil-water-plant relationships.
Identifiers: Soil moisture sampling, Sampling error.

Soil moisture variability in the upper 5-8 cm of the soil is considered in two connected studies. One covers variability over large and small areas, based on taxonomic units; the other, sample sizes required to give accurate estimates of mean values. The gravimetric method is used and various statistical tests are applied to the data. Variability is marked over large (6 sq km) and very small (2.4 sq m) areas. In the study, 2 groups emerge: the smaller, less than 950 sq m; and the larger, several drainage classes and a catchment area. These require, with a standard error of 2.5 at the 0.05 probability level, 4-19 and 44-80 samples respectively. Samples of only a few 'individuals' are shown to give misleading results and therefore some soil survey techniques and the calibration of soil moisture measuring equipment are questioned. Changes in soil moisture variability through time must also be considered. (Knapp-USGS)
W69-08002

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 3. COMPARISON OF FIELD AND LABORATORY DATA ON RETENTION AND OF MEASURED AND CALCULATED CONDUCTIVITIES,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
K. J. Brust, C. M. H. Van Bavel, and G. B. Stirk.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 322-326, May-June 1968. 5 p, 4 fig, 2 tab, 14 ref.

Descriptors: *Water storage, *Soil water, *Soil water movement, *Hydraulic conductivity, *Retention, Osmotic pressure, Moisture stress, Moisture tension, Field capacity, Moisture uptake.
Identifiers: Root extraction (Water).

Soil water characteristics obtained on soil cores in the laboratory at air pressures less than 1 bar agreed substantially with pressure-water content relations determined in the field. Thus, in field studies of soil hydraulics, measurement of either water content or pressure potential may suffice. When the laboratory data were supplemented with a double-tube measurement of the saturated conductivity, the relation between water content and conductivity was calculated using 2 methods. Of these, the one due to Millington and Quirk gave less accurate agreement with actual field measurements than did the method proposed by Laliberte, Corey and Brooks. The latter method, when based on double-tube measurements in the field and pressure cells or similar measurements on cores in the laboratory, appears useful. Retention values measured with the pressure membrane method on disturbed soil samples were out of line with both field and core results, even when the disturbing treatments were minimized. (Knapp-USGS)
W69-08025

MATHEMATICAL SIMULATION OF WATER MOVEMENT THROUGH UNSATURATED NONHOMOGENEOUS SOILS,
Harvard Univ., Cambridge, Mass. Dept. of Water Resources.
Flora Chu Wang, and V. Lakshminarayana.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 329-334, May-June 1968. 6 p, 6 fig, 1 tab, 16 ref.

Descriptors: *Unsaturated flow, *Soil water movement, *Mathematical models, Digital computers, Synthetic hydrology, Diffusion, Hydraulic conductivity, Capillary action.
Identifiers: Nonlinear diffusion equation.

The general states of flow of water through unsaturated nonhomogeneous soils have been simulated by the nonlinear diffusion equation. A numerical technique is developed and programmed for the IBM 7094 to solve the explicit-implicit difference scheme analog of the nonlinear partial differential equation of parabolic-type. The data utilized in this study for the simulated soil profile are obtained from the experimental work of Nielsen et. al. (1964) for vertical drainage and infiltration. Computed cumulative loss and average rate are in reasonable agreement with their field measurements. The results indicate that the average rate of drying and wetting are controlled largely by the

physical properties of the soil and their corresponding boundary conditions. (Knapp-USGS)
W69-08026

2H. Lakes

THE EFFECT OF PUMPED-STORAGE RESERVOIR OPERATION ON BIOLOGICAL PRODUCTIVITY AND WATER QUALITY,
Virginia Commonwealth Univ., Richmond; and Virginia Polytechnic Inst., Blacksburg.
For primary bibliographic entry see Field 05C.
W69-07711

MICROBIOLOGICAL RESEARCH OF THE GLUBOKOYE LAKE NEAR THE MOLODEZHNAYA STATION (RUSSIAN),
Arkticheskii i Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR); Leningrad Higher School of Marine Engineering (USSR); and Moscow State Univ. (USSR).
A. E. Kriss, M. V. Aleksandrov, A. M. Kozlovskiy, K. V. Ledeneva, and O. N. Leflat.
Informatzionnyy Byulleten' 70, Sovetskoy Antarkticheskoy Ekspeditsii, pp 44-48, 1968. 5 p, 2 tab, 7 ref.

Descriptors: *Lakes, *Microbiology, *Antarctic, Ice, Temperature, Oxygen, Bacteria, Salinity, Water levels, Sea level, Ions, Freezing, Sodium, Chemical analysis, Chlorine, Iron, Calcium, Magnesium, Sulfur bacteria.
Identifiers: *Lake Glubokoye, Antarctic microbiological study.

Microbiological and chemical characteristics of the Glubokoye Lake located in the vicinity of the Molodezhnaya Antarctic station were investigated on the basis of the author's field work and earlier publications. The study shows that the lake of 1300m x 500m dimension and of 36m maximum depth contains carbonate, bicarbonate, Cl, sulfate, Mg, Na, K, and Fe ions and micrococcus, achromobacter, and mycobacteria. In general the lake can be considered as belonging to the ultrafresh water type containing not more than 40 mgr/l of mineralized matter. (Gabriel-USGS)
W69-07752

PRINCIPAL LAKES OF THE UNITED STATES,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
W69-07770

MECHANICAL HARVESTING OF LAKE WEEDS APPEARS PROMISING FOR HALTING AGING PROCESS,
Wisconsin Univ., Madison. University-Industry Research Program.
Gerald D. Seinwill.
UIR/Res Newsletter, Vol 3, No 3, Wisconsin Univ, Madison, pp 16-17, August 1968. 3 fig, disc.

Descriptors: *Aquatic weed control, Aquatic plants, Eutrophication, Wisconsin.
Identifiers: *Mechanical harvesting, Aquatic plant distribution, Compositional index, Harvesting frequency, Myriophyllum exalbescens, Lake Mendota, Wisconsin.

Mechanical harvesting techniques are used as a control method of increased plant growth in lakes, resulting from overenrichment. To provide increased information concerning the types of plants involved and effects of harvesting, the Wisconsin Water Resources Center sponsored a study by University of Wisconsin personnel. The first phase identified and mapped the plant communities in Lake Mendota's University Bay. Species distribution was attributed to bottom soil texture and water depth. A compositional index was calculated by recording species composition of each community in terms of percent frequency and relative frequency of each species. Index ranged from 100 in low nutrient to 400 in high nutrient lakes. Compositional replacement (changes in species and relative importance of each) has taken place since 1922 studies. Compositional index has increased from 294 to 381, with predominant nuisance species presently being Myriophyllum exalbescens. The second phase, determining effects of harvesing, utilized uncut control sections and harvesting sections at various depths and bottom types. Harvesting is concluded to be a successful control measure by reducing regrowth and density, since all cut stems do not resprout immediately. One caution is the necessity of future sampling to monitor changes in species composition as other plants appear to fill the void. (Ketelle-Wisc)
W69-07815

THE EXCHANGE OF DISSOLVED SUBSTANCES BETWEEN MUD AND WATER IN LAKES,
Freshwater Biological Association, Ambleside (England).
Clifford H. Mortimer.
J Ecol, Vol 30, pp 147-201, 1942. 46 fig, 5 tab, 77 ref.

Descriptors: *Mud-water interfaces, *Lakes, Eutrophication, Oligotrophy, Sediments, Reduction (Chemical), Mud, Nutrients, Oxygenation, Oxidation-reduction potential, Conductivity, Circulation, Hypolimnion, Water chemistry, Cycling nutrients.
Identifiers: *Dissolved solutes, *Mud-water exchange, Jenkin sampler, Windermere, Esthwaite Water, Redox, Chemical stratification, Oxygen absorption rate, Eddy diffusion.

Seasonal variation in stratification of temperature, oxygen, alkalinity, pH, ammonium ion, nitrate ion, nitrite ion, silicon, phosphorus, ferric iron, ferrous iron, total iron, and sulfide ion, were illustrated in a series of depth-time diagrams for Esthwaite Water and Windermere lakes. Concurrently, the study of the distribution of redox potential, pH, and conductivity were determined with depth of the undisturbed cores of mud and water above the mud surface. Investigation of seasonal changes in a central water column and underlying mud in five English lakes disclosed relationships between the winter oxygen concentration above the mud surface, mean winter thickness of surface-oxidized mud layer, winter reducing intensity of mud, winter conductivity in mud, organic content of mud, and mean summer oxygen depletion rate in hypolimnion, expressed per unit area of mud surface. Reduction of the mud surface and the associated increase in supply of solutes to the water may be expected to augment plankton production. Examples are quoted. A description of the Jenkin surface mud sampler and the arrangement of redox and conductivity electrodes are given. (Bortleson-Wisc)
W69-07827

ECOLOGICAL HISTORY OF THE ENGLISH LAKE DISTRICT,
W. H. Pearsall, and W. Pennington.
Journal of Ecology, Vol 34, No 1, pp 137-148, Feb 1947. 2 fig, 1 tab, 8 ref.

Descriptors: *Paleolimnology, *Ecology, *History, *Erosion, *Lakes, *Sedimentation, *Eutrophication, Cores, Pollen, Organic matter, Sediments.
Identifiers: *English Lake District, Windermere, Archaeology, Paleoecological studies, Historical lake ecology, Watershed erosion.

The paper contains a summary of the archaeological background of the English Lake District and attempts to correlate the historical record with depth profile patterns of pollen and organic matter in sediment cores of Windermere. Evidence from the pollen and chemical analyses suggest that Windermere drainage system passed through the following stages: (1) a late glacial and immediate post-glacial phase of rapid erosion and stabilization by vegetation (pine-birch forest), (2) a steady state of alder woods and oak forest, (3) a phase of primary (upland) occupation by man and incipient pine forest degeneration (1500 BC to AD 900), (4) a period of secondary (valley) occupation by Norse, increased grazing and accelerated degeneration (900-1300 AD) accompanied by draining alder swamps, (5) period of economic exploitation for wool and timber (c 1300-1750 AD) with extreme woodland and soil degeneration, and (6) romantic period of replanting and amenity exploitation (1750-1940 AD). (Bortleson-Wisc)
W69-07828

SAMPLER FOR STUDIES OF THIN HORIZONTAL LAYERS,
Washington Univ., St. Louis, Mo. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W69-07829

LIMNOLOGICAL CONDITIONS AND GROWTH OF TROUT IN THREE LAKES NEAR ROTORUA,
Marine Dept., Rotorua (New Zealand).
For primary bibliographic entry see Field 05C.
W69-07831

A TRACER EXPERIMENT WITH I-131 IN AN OLIGOTROPHIC LAKE,
Helsinki Univ. (Finland). Dept. of Radiochemistry.
For primary bibliographic entry see Field 05C.
W69-07859

THE SUBMERGED AQUATICS OF UNIVERSITY BAY: A STUDY IN EUTROPHICATION,
Wisconsin Univ., Madison. Dept. of Botany.
For primary bibliographic entry see Field 05C.
W69-07866

SOME LIME-INDUCED CHANGES IN LAKE METABOLISM,
Wisconsin Univ., Madison. Lab. of Limnology.
For primary bibliographic entry see Field 05C.
W69-07868

LAKE LYNGBY SO: LIMNOLOGICAL STUDIES ON A CULTURALLY INFLUENCED LAKE,
Copenhagen Univ., Hillerod (Denmark). Freshwater-biological Lab.
For primary bibliographic entry see Field 05C.
W69-07870

RECENT SEDIMENTATION CONDITIONS IN THE ILE SAINT PAUL LAGOON,
Akademiya Nauk SSSR. Institut Okeanologii.
Yu A. Bogdanov, V. I. Kuksa, F. A. Pasternak, and Ye A. Romankevich.
Engl edition of Akad Nauk, SSSR, transl by Amer Geophys Union, Wash, DC. Oceanology, Acad Sci of USSR, Vol 7, No 4, pp 494-500, 1967. 7 p, 5 fig, 1 tab.

Descriptors: *Lagoons, *Sedimentation, *Sediment distribution, Volcanoes, Hydrologic properties, Salinity, Water temperature, Velocity, Diatoms, Plankton, Suspension, Carbon, Organic compounds, Crustaceans, Detritus, Plants, Biomass, Aquatic life, Pollutants, Hydrogen sulfide, Benthic fauna.
Identifiers: *Ile Saint Paul lagoon sedimentation, Lagoon sedimentation process.

This article describes the results of the hydrological, geological, biological, and topographical study of the lagoon conducted by the personnel of the R. V. Vityaz during its 36th voyage. The study shows that the hydrodynamic features of the water have a favorable effect on the development of plankton. Diatom content in the suspended matter varies from 1,650 to 17,230 cells per liter, with the maximum number of diatoms found in the surface-water layer near the western shore. Vertically, the amount of organic matter in the suspended matter

decreases rapidly, and less than 5% of the organic matter recorded at the surface is retained at the bottom. The extreme paucity of the benthic population in the deeper parts of the lagoon may be explained by the accumulation there of vast masses of rotting macrophytes. The characteristics of bottom sediments of the lagoon at several stations are analyzed and given graphically. (Gabriel-USGS)
W69-07978

LAKES IN THE CROATIAN LIMESTONE REGION,
Milivoj Petrik.
Hydrol of Fractured Rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 565-589, 1967. 25 p, 11 fig, 23 tab, 37 ref.

Descriptors: *Lakes, *Lake morphology, *Limestones, *Water analysis, Hydrologic properties, Thermal stratification, Fractures (Geology), Geochemistry, Geomorphology, Carbonates, Magnesium, Carbon, Oxygen, Chloride, Carbon dioxide, Water structure, Springs.
Identifiers: *Yugoslavia, Croatia, Dalmatia, Islands of Cres and Krk.

This article describes the natural accumulation of water in the limestone region of Croatia, Yugoslavia and contains the analysis of hydrologic, geological, and geochemical conditions present in the several lakes of Dalmatia and of the Krk and Cres islands. The study shows that (1) the lakes of the region are characterized by a relatively low productivity; (2) the water is of the hydrocarbonate type with a mineral content characteristic of spring waters of the lake region; (3) sufficiently deep lakes (about 15 m) show clear thermal stratification; (4) the genesis of water accumulation is of variable character; and (5) development and maintenance of a lake depends upon several factors, the main ones of which are the meteorological conditions and the transmission capacity of subterranean channels. (Gabriel-USGS)
W69-07983

HYDROLOGIC ANALYSIS FOR LAKE ONTARIO: STOCHASTIC ASPECTS OF EVAPORATION.
Cornell Univ., Ithaca. School of Civil Engineering.
For primary bibliographic entry see Field 02D.
W69-08116

A CONTINUED PRE- AND POSTIMPOUNDMENT SURVEY OF THE HELMINTH AND CRUSTACEAN PARASITES OF MICROPTERUS DOLOMIEUI LACAPEDE, M. PUNCTULATUS (RAFINESOUE) AND M. SALMOIDES (LACEPEDE) (PERCIFORMES) OF BEAVER RESERVOIR IN NORTHWESTERN ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Zoology.
Wilbur B. Owen.
M.S. Thesis, University of Arkansas, Fayetteville, Arkansas 1969. 57 p, 4 tab, 3 fig, ref, 1 appendix. OWRR Project A-009-ARK.

Descriptors: *Parasites, *Impoundment, *Life cycle, *Physico-chemical fluctuations, Water quality, Intermediate hosts.

The intent of this research was continued pre- and postimpoundment survey to determine the species, number, and extent of parasite infections of Micropterus dolomieui, M. punctulatus, and M. salmoides in Beaver Reservoir in Northwestern Arkansas. A comparison of the fluctuations of parasitism in the three hosts from pre-impoundment through postimpoundment was made. Fluctuations of parasites were compared for three years following the impoundment of the White River watershed. A further objective of this study was to correlate fluctuations in the physicochemical water qualities of the reservoir with the qualitative and quantitative fluctuations of parasitism of the three hosts. Based on the data of this study it is concluded that the explanations of the fluctuations of the parasites following impoundment of the White River depend on the nature of the life cycles of the parasites. The data indicate that in order to draw significant conclusions concerning the correlation of physico-chemical water quality fluctuations, at least 4 to 5 years postimpoundment monitoring of water qualities is necessary.
W69-08121

2I. Water in Plants

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 1. INTERPRETATION OF WATER CONTENT AND PRESSURE PROFILES,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W69-07966

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 2. THE WATER BALANCE OF THE ROOT ZONE,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W69-07967

WATER DISPOSITION IN A STREAM CHANNEL WITH RIPARIAN VEGETATION,
Arizona Agricultural Experiment Station, Tucson; Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center; and Arizona Univ., Tucson. Dept. of Soil Physics.
For primary bibliographic entry see Field 03B.
W69-07976

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 3. COMPARISON OF FIELD AND LABORATORY DATA ON RETENTION AND OF MEASURED AND CALCULATED CONDUCTIVITIES,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W69-08025

2J. Erosion and Sedimentation

FORMATION OF FLOOD PLAIN LANDS,
Army Engineer District, New Orleans, La.
For primary bibliographic entry see Field 04A.
W69-07707

TREND-SURFACE ANALYSIS OF THE BASIN AND RANGE PROVINCE, AND SOME GEOMORPHIC IMPLICATIONS,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 04A.
W69-07730

CHANGES IN THE CHANNEL MORPHOLOGY OF TRINITY RIVER AND EIGHT TRIBUTARIES IN CALIFORNIA, 1961-65,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02E.
W69-07747

SPRING BOTTOM SEDIMENTS AS INDICATORS OF HIDDEN MERCURY MINERALIZATION (RUSSIAN),
Akademiya Nauk Tadzhikskoi SSR, Dushanbe. Inst. of Geology.
T. N. Nasimov, and Kh. M. Yusupov.
Dokl Akad Nauk Tadzh SSR, Vol 11, No 10, pp 54-56, 1968. 3 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Springs, *Sediments, *Indicators, *Mining engineering, Paleozoic era, Geology, Geomorphology, Geochemistry, Exploration, Trace elements, Spectroscopy, Copper, Lead radioisotopes, Zinc radioisotopes.
Identifiers: Spring sediment trace elements.

Spring bottom sediments were analyzed in carrying out the prospecting for mineral deposits in the vicinity of the Kavnok mercury occurrence. The prospecting consisted of the analysis for trace elements (copper, mercury, zinc, and antimony), of all the occurrences of surface and underground waters in the area. The study shows that the analysis of spring bottom sediments is a valuable addition to the application of hydrochemical methods in prospecting for mercury and delineation of ore-bearing areas. (Gabriel-USGS)
W69-07749

DOWNSTREAM CHANGES IN SEDIMENTOLOGICAL PARAMETERS ILLUSTRATED BY PARTICLE DISTRIBUTION FROM A BREACHED ROCKFILL DAM,
Geological Survey, Sacramento, Calif.
Kevin M. Scott.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 309-318, 1967. 10 p, 4 fig, 12 ref.

Descriptors: *Sediment transport, *Floods, *Historic flood, *California, *Particle size, Dam failure, Erosion, Sedimentation, Discharge (Water), Tracers, Channels, Deposition (Sediments), Tractive forces.
Identifiers: Rubicon River (Calif).

A flood surge at least the equal of any post-Pleistocene discharge was released by failure of a rockfill dam in the glacial canyon of the Rubicon River, California. The diorite rockfill in the dam embankment acted as a point source of boulders that could be traced downstream. Particle roundness changes were rapid, transition from angular to subangular occurred almost immediately after initiation of movement, and change from subrounded to rounded took place approximately 1.5 mi downstream. Over 90% of the size reduction downstream is due to progressive sorting. Movement of the rockfill continued to a point 1.6 mi downstream. Sorting of these deposits increased irregularly downstream. Macroturbulent transport resulted in the accretion of 5 feet of coarse material on a terrace level 28 ft above thalweg at a peak stage of 45 ft. Terrace-like berms formed in backwater areas and flow or wave fronts up to 7 ft high formed lobate scarps transverse to the channel. Great lateral supply of coarse material to the channel was caused by the surge but only short increments of longitudinal transport occurred. (Knapp-USGS)
W69-07754

FLUVIATILE MORPHOGENESIS OF ROUNDNESS: THE HACKING RIVER, NEW SOUTH WALES, AUSTRALIA,
Makerere Univ. Coll., Kampala (Uganda). Dept. of Geography.
Joseph P. B. M. Ouma.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 319-344, 1967. 26 p, 16 fig, 2 tab, 14 ref.

Descriptors: *Sediment transport, *Particle shape, *Particle size, *Abrasion, Channel flow, Rivers, Statistical methods, Correlation analysis, Sands, Gravels, Alluvial channels, Alluvium.
Identifiers: *New South Wales (Australia), *Hacking River (Australia).

An intensive lithological, mechanical and morphological investigation into the sediments of the Hacking River, New South Wales, Australia is summarized. Particle roundness increases as calibre decreases, but in sub-granule grades roundness declines as size decreases. Unweighted mean roundness does not approach 1.0 asymptotically

downstream, but first increases to a maximum, whence it declines downstream. Roundness changes at a medium rate in above-cobble grades, fastest in cobble-granule range, and slowest in the sub-granule grades. Mean roundness evolves downstream faster than calibre decreases, and calibre declines faster than mean sphericity evolves. Roundness in the Hacking does not change at confluences, because of small tributaries and petrographic uniformity of the catchment. While roundness dispersion and roundness skewness evolve downstream irregularly in the Hacking, in long sandy rivers roundness decreases downstream; unweighted mean roundness is attained, and roundness approaches+1.0 asymptotically downstream. (Knapp-USGS)
W69-07755

VARIATION OF THE CHARACTERISTICS OF DELTAIC AND STREAM BED DEPOSITS IN LABORATORY STUDIES,
Colorado State Univ., Fort Collins. Dept of Civil Engineering; and Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
T. A. Reid, R. H. Brooks, and D. B. Simons.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 345-354, 1967. 10 p, 6 fig, 1 tab, 5 ref.

Descriptors: *Sedimentation, *Deltas, *Hydraulic models, Model studies, Sediment transport, Reservoir silting, Sedimentary structures, Sediment distribution, Sedimentology, Stratification.
Identifiers: Delta sedimentation model.

The major processes that influence deltaic sediment distribution were studied in a laboratory flume and stilling basin. The quantity and size of sediment, the discharge of water, and the still water level were held constant. The flume was 30.5 m long, 7.32 m wide, and 0.61 in deep. Standard deviation, skewness, and kurtosis of the data are summarized graphically. As the height of the delta decreased, standard deviation of the grain size increased because length of foresets diminished, lessening the length of path available for sorting. There was no apparent increase in kurtosis and skewness with mean grain size. There was a cyclic change in particle size alone, cross sections during deposition. Particle size increased down the foresets. The relation of flow parameters to size distribution may be used to predict reservoir sedimentation or to calculate past flows from preserved sedimentary sequences. (Knapp-USGS)
W69-07756

VARIATIONS OF SEDIMENT TRANSPORT IN THE WASHITA RIVER,
Agricultural Research Service, Chickasha, Okla. Soil and Water Conservation Research Div.
Paul B. Allen, and Norman H. Welch.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 355-366, 1967. 12 p, 5 fig, 2 tab, 8 ref.

Descriptors: *Sediment transport, *Sediment yield, Alluvial channels, Suspended load, Sediment discharge, Channel morphology, Sediment load.
Identifiers: Washita River (Okla), Sediment load estimation.

Studies of sedimentation and stream velocity on the Washita River, Oklahoma show that transport is markedly different in bedrock and straight, curved, wide, and narrow sand channels. Measured sediment discharges are compared with discharges calculated by the Brooks, Einstein, and Colby methods and the results are tabulated. The Brooks procedure is believed to be fairly accurate in a sampled wide channel. The Colby method compared well, but the Einstein method estimated too low a value. (Knapp-USGS)
W69-07757

REGIONAL DIFFERENTIATIONS OF THE SUSPENDED SEDIMENT TRANSPORT IN THURINGIA AND THEIR RELATION TO SOIL EROSION,
Deutsche Akademie der Landwirtschaftswissenschaften zu Berlin (East Germany).
L. Bauer, and W. Tille.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 367-377, 1967. 11 p, 4 tab, 21 ref.

Descriptors: *Sediment transport, *Suspended load, *Erosion, *Provenance, Sediment yield, Sediment discharge, Silts, Sands, Discharge (Water), Streamflow, Runoff.
Identifiers: *Thuringia (Germany), Unstrut River.

During the hydrologic years 1961 and 1962, 13 sampling stations within the watershed of the river Unstrut, Germany, carried out systematic measurements of the suspended sediment charge. Statistical analysis of the data showed partially significant differences between the mean values of different cross sections within the area which covers only about 5,000 sq km. The functions for estimating suspended sediment discharge, which state the average increase of the suspended sediment discharge in g/s with the water discharge in cu m/sec were calculated for 11 cross sections after the simplified method of Remy-Berzencovich (1960). Sediment discharges are tabulated. (Knapp-USGS)
W69-07758

DRIFT BALANCE OF THE KURA RIVER IN ITS LOWER COURSE,
Akademiya Nauk Azerbaidzhanskoi SSR, Baku. Institut Geografii.
S. G. Rustamov.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 391-400, 1967. 10 p, 1 fig, 1 tab.

Descriptors: *Sediment transport, *Suspended load, *Regime, *River regulation, Reservoirs, River training, Water management (Applied), Bank erosion, Sedimentation.
Identifiers: *USSR, *Kura River (USSR), Arax River (USSR).

Construction of the Mingechaur reservoir on the Kura River, USSR, abruptly changed the river's characteristics, particularly its sediment load and meander form. Regulation changed annual streamflow from 18.7 cu km to 16.7 cu km. Suspended load decreased from 211 g/cu m to 25 g/cu m above the confluence of the Arax River and from 2,007 to 1,651 gm/cu m below the confluence. Deposition on the flood plain decreased from 38 to 19.2 million tons. The amplitude and rate of migration of meanders greatly decreased. (Knapp-USGS)
W69-07759

SEDIMENT TRANSPORTATION IN RIVER CHANNELS WITH FLOOD PLAINS,
Gidrometeorologicheskii Institut, Leningrad (USSR).
N. B. Barishnikov.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 404-412, 1967. 9 p, 2 fig, 1 tab, 12 ref.

Descriptors: *Sediment transport, *Alluvial channels, *Model studies, *Floods, *Flood plains, Hydraulic models, Alluvium, Sediment load, Sediment discharge, Sands, Turbulence, Streamflow, Velocity.
Identifiers: USSR, Stream models.

The influence of turbulence on alluvial channel sediment load was studied in over 200 flume experiments. The channels studied had rectangular cross sections and unilateral rectangular flood plains. The channel discharge decreased markedly when the flood plain and channel discharged together. This decrease was directly proportional to flood plain hydraulic roughness. The mean channel velocity decreased and velocity distribution in the channel became more uniform when water flowed on the flood plain. (Knapp-USGS)
W69-07760

THE EFFECT OF WATER DETENTION STRUCTURES ON RIVER AND DELTA MORPHOLOGY,
Colorado State Univ., Fort Collins, Dept. of Civil Engineering; and Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch.
H. Y. Chang, D. B. Simons, and R. H. Brooks.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 438-448, 1967. 11 p, 6 fig, 1 tab.

Descriptors: *Sedimentation, *Bed load, *Deltas, *Channel morphology, Model studies, Hydraulic models, Alluvial channels, Dams, Banks, Beds, Channel improvements, Structures, Hydraulics, Flood control, Storage.
Identifiers: Delta morphology.

The effect of flood-water retarding and sediment detention structures upon river morphology, including aggradation of river channels and reservoir deltas, has been studied in a large laboratory model basin. Constant rates of water and sediment (essentially bed-materials) were fed into a channel with a resulting flow of water and sediment into a reservoir at a constant depth. The banks of the channel were made stable for most of the runs. The river and delta morphology are discussed in terms of channel aggradation and degradation induced by delta growth and a sudden change of sediment feeding rate, water discharge, reservoir base level, or delta thickness. Shape factor for deltas is defined as the width-length ratio of the deltas when approximated as the shape of an ellipse. The shape factor generally increases in value for deltas developed when the channel is aggrading, and decreases in value for deltas developed when the channel is degrading. The mechanics of river flow and the accompanying changes in delta shape are discussed in terms of equivalent stream length. (Knapp-USGS)
W69-07761

THE RESULTS OF CONTINUOUS BED LOAD MEASUREMENTS RELATED TO FLUCTUATIONS OF THE RIVER BED,
Netherlands Rijkswaterstaat, Arnhem. Section of River studies.
A. Zanen.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 75, pp 489-500, 1967. 12 p, 6 fig, 5 ref.

Descriptors: *Bed load, *Sampling, *Measurement, Laboratory tests, Dunes, Sediment transport, Model studies, Hydraulic models.
Identifiers: Bed load sampling.

The relation between bed load movement and location on duned beds was studied in the laboratory to determine optimum bed load sampling and sampler calibration techniques. Sand transport is intermittent, with maximum movement at dune crests and minimum movement just downstream. The amount of sand caught in a sampler depends on its position on dunes. Modification of sampling techniques to sample all parts of several dunes will give more representative results. (Knapp-USGS)
W69-07762

SEDIMENT TRANSPORTATION AND THE MEANS OF ITS ESTIMATION,
State Hydrological Inst., Leningrad (USSR).
N. S. Znamenskaja, A. N. Ljapin, and I. V. Popov.
Comm of Surface Waters, Proc Gen Assembly of Bern (Sept-Oct, 1967), Int Ass Sci Hydrol, Pub No 75, pp 507-516, 1967. 4 fig.

Descriptors: *Sediment transport, *Alluvial channels, *Measurement, *Estimating, Channel morphology, Dunes, Turbulence, Roughness (Hydraulic), Meanders.

Identifiers: USSR, Sediment transport estimation.

River bed evolution is a form of sediment transportation by flowing water. River bed evolution can be divided into 2 types distinguished by dune motion of sediments and meandering. A system of characteristics expressing principal deformation features peculiar to different types of river bed evolution was elaborated. Mapping showed some relations between individual morphometrical characteristics, deformation velocity and influencing factors. By means of hydromorphological analysis, it is possible to simplify choice of engineering structures location, choose the most effective defense measures, and forecast river bed deformation. One of the computation methods is based on consideration of dune motion and its dependence on hydraulic factors, and may be used to solve many engineering problems, including bed-load discharge determination, channel form migration, minimum and maximum depths, channel sedimentation, erosion of the dune crest, etc. Another computation method correlates channel forms with abruptly changing flows. (Knapp-USGS)
W69-07763

TRANSPORT VELOCITIES OF SINGLE PARTICLES IN BED-LOAD MOTION,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.; and Uppsala Univ. (Sweden). Dept. of Physical Geography.
Nils Meland, and John Norrman.
Geogr Ann, Vol 48A, No 4, pp 165-182, 1966. 18 p, 6 fig, 1 tab, 28 ref.

Descriptors: *Sediment transport, *Bed load, *Model studies, *Hydraulic models, Laminar flow, Turbulent flow, Reynolds number, Particle size, Shape, Roughness (Hydraulic), Saltation, Velocity.
Identifiers: Bed load transport.

In order to determine the influence of shear velocity, bed roughness and moving particle diameter on particle bed-load transport, velocities of single spherical glass beads moving over beds of rhombohedrally packed spherical glass beads were determined under controlled laboratory conditions. A relationship between the position of zero water velocity and bed roughness is established. Three stages of particle motion are recognized from a plot of bead velocity on particle diameter. The degree of development of each is a function of all three major variables. An empirical solution is offered where particle velocity is considered a function of shear velocity, bed roughness, and particle diameter. A more detailed consideration of the forces which tend to propel and retard a moving particle leads to the development of a semi-empirical expression for the velocity of a single particle in contact-load motion. (Knapp-USGS)
W69-07769

SEDIMENTATION ENGINEERING CHAPTER VI: ECONOMIC ASPECTS OF SEDIMENTATION,
For primary bibliographic entry see Field 04D.
W69-07794

SEDIMENT RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY,
Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 05C.
W69-07851

PESTICIDE RESIDUES IN SEDIMENTS OF THE LOWER MISSISSIPPI RIVER AND ITS TRIBUTARIES,
National Communicable Disease, Atlanta, Ga.; Food and Drug Administration, Washington, D. C.; Agricultural Research Service, Oxford, Miss. Sedimentation Lab.; and Agricultural Research Service, Gulfport, Miss. Plant Pest Control Div.
For primary bibliographic entry see Field 05B.
W69-07921

STUDIES ON THE SAND TRANSPORT IN STREAMS WITH TRACERS,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Katsumasa Yano, Yoshito Tsuchiya, and Masanori Michiue.
Bull of Disaster Prev Res Inst, Kyoto Univ, Vol 18, Part 3, No 141, pp 1-16, Feb 1969. 16 p, 18 fig, 2 tab, 11 ref.

Descriptors: *Sediment transport, *Stochastic processes, *Mathematical models, *Hydraulic models, Model studies, Flumes, Sediment discharge, Sediment load, Bed load, Sands, Gravels, Flumes, Streams.
Identifiers: Japan.

A stochastic model of the transport of uniformly graded sand and gravel in streams is proposed. The model was verified using colored sand as tracers in alluvial streams and in laboratory flumes. Model calculations were in good agreement with experimental values. Sand grains move in steps, with an average length of about 80-250 times grain diameter. Step length increases with flow intensity. At high intensity, sediment discharge increases with step length, but at low intensities, sediment discharge is a function only of probability of initiation of grain movement. (Knapp-USGS)
W69-07931

FLUVIATILE OBSTACLE MARKS FROM THE WADIS OF THE NEGEV (SOUTHERN ISRAEL),
Geological Survey of Israel (Jerusalem).
Iaakov Karcz.
J Sediment Petrol, Vol 38, No 4, pp 1000-1012, Dec 1968. 13 p, 15 fig, 39 ref.

Descriptors: *Scour, *Channel flow, *Stream erosion, Sedimentary structures, Ripple marks, Sands, Arid lands, Silts, Clay, Turbulence, Bed load.
Identifiers: Negev (Israel), Wadis, Current crescents.

Current crescents and several types of obstacle shadows, the result of both scouring and deposition, appear along the pebble-lined beds of the ephemeral streams (wadis) of the Negev. These structures are formed by secondary currents which originate when the main flow is deformed by obstacles within the stream path. The hydraulic mechanisms of the formation of the structures are described and shown by diagrams. (Knapp-USGS)
W69-07944

CARBONATE TURBIDITES, GULF OF MEXICO,
Texas A and M Univ., College Station. Dept. of Geology.
David K. Davies.
Contract No. 14-08-0001-10866 USGS. Proj No. 15265 Texas A and M. J Sediment Petrol Vol 38, No 4, pp 1100-1109, Dec 1968. 10 p, 8 fig, 1 tab, 29 ref.

Descriptors: *Sedimentation, *Carbonates, *Limestones, *Turbidity currents, *Gulf of Mexico, Continental slope, Oceans, Sediment transport, Provenance.
Identifiers: Carbonate turbidites.

Carbonates of shallow water origin have been recovered from an area of some 39,000 sq mi in the Gulf of Mexico abyssal plain. These carbonates occur most commonly as layers of variable thickness (2-120 cm) in cores of Pleistocene-Recent sediments. Cores from the southern edge of the abyssal plain reveal a remarkable lithologic simplicity and orderliness, characterized in general by a vertical repetition of members: (1) a basal white or light gray, medium calcilutite, 30 cm in average thickness, which is commonly cross-laminated and contains an abundant shallow water benthonic fauna; overlain by (2) a light olive-gray, fine calcilutite, some 35 cm in average thickness, which is commonly bioturbated and consists of a mixture of comminuted shells, micrite, and argillaceous lutite and which contains both planktonic and shallow water benthonic fauna; (3) an olive gray-olive black argillaceous lutite, 50 cm in average thickness, which may be bioturbated or structureless, and which contains a scattered planktonic fauna. Each core consists of several such sequences, each of which represents deposition from a mature turbidity-current that originated on the Campeche Shelf, and which was followed by a period of characteristic abyssal plain sedimentation of argillaceous lutites. Areal distribution of the turbidites suggests that occasionally the flows travelled beyond the present northern limits of the abyssal plain--a total travel path of 350 miles. The tremendous quantities of detrital sediment that originated from the Mexico and Texas continental shelves, as well as from the Mississippi River, either buried the carbonate turbidites beyond coring depths or diluted these flows in the southwest, northwest, and east of the abyssal plain. (Knapp-USGS)
W69-07945

REWORKING OF GLACIAL SEDIMENTS IN THE NORTHWEST ARM, A FJORD-LIKE INLET OF THE SOUTHEAST COAST OF NOVA SCOTIA,
Smithsonian Institution, Washington, D. C. Div. of Sedimentology.
Daniel J. Stanley.
J Sediment Petrol, Vol 38, No 4, pp 1224-1241, Dec 1968. 18 p, 14 fig, 43 ref.

Descriptors: *Estuaries, *Sedimentation, *Glacial drift, Erosion, Deposition (Sediments), Sediment transport, Silting, Partial size, Particle shape, Sediment distribution.
Identifiers: Halifax (Nova Scotia), Sediment reworking.

The morphology, water mass properties, and sediments in a small fjord-like inlet on the Atlantic coast of Nova Scotia, the North West Arm, were examined in an attempt to evaluate processes related to the reworking of glacial drift in the marine environment. The Arm, an open system with physical, chemical, and biological exchanges with areas beyond its mouth, is not a simple 'sediment trap'. The present sediment distribution conforms closely with morphological features and with patterns of current flow. The original Pleistocene diamictite till deposits (gravel to mud admixtures) have been mechanically reorganized during the period following submergence of the former glaciated valley. Winnowing and by-passing, when carried to completion, result in the formation of gravel pavements in areas strongly affected by currents and in the deposition of fine-grained material on less current-agitated bottoms. Less well-sorted textural varieties result from incomplete winnowing, and from the introduction of fine-grained material on coarse gravel 'lag' pavements. These intermediate sediment types, gradational between original till deposits and better sorted mud and gravel end-members, clearly do not fall in either relict or modern sediment categories as usually defined. The patchy nature of the sediment distribution and the wide range of textural types observed in the Arm are characteristics common of submerged coastal embayments and shelves off glaciated regions in general. It is quite likely that some of the processes still active in the North West Arm are of the type that modified Pleistocene glacial drift on continental margins during early phases of the transgression by the Holocene sea. (Knapp-USGS)
W69-07946

SEDIMENTATION IN AN ARCTIC LAKE,
Department of Energy, Mines and Resources, Burlington (Ontario). Great Lakes Div.; and Ottawa Univ. (Ontario). Dept. of Geology.
J. P. Coakley, and B. R. Rust.
J Sediment Petrol, Vol 38, No 4, pp 1290-1300, Dec 1968. 11 p, 7 fig, 2 tab, 18 ref.

Descriptors: *Sedimentation, *Arctic, *Lakes, Cold regions, Silts, Sands, Mud, Permafrost, Freezing, Sediment transport, Deposition (Sediments).
Identifiers: Stanwell-Fletcher Lake (Canada).

Stanwell-Fletcher Lake is 400 mi north of the Arctic Circle, covers 131 sq mi, and is over 100 m deep. Its size and the severe climate restrict summer melting of ice to the margins. The ice insulates the water, which remains essentially isothermal, warming slightly from 1.3 to 1.6 deg C, during the summer. Inflowing water is nearer 4 deg C, and therefore sinks and mixes with the lake water, a process which maintains thermal and chemical homogeneity in the lake and oxygenates the surficial bottom sediment. Sedimentation is very slow because of the short period of stream flow and the low organic activity in the lake. Silty sand derived from river bed loads accumulates on shallow marginal deltas and shelves. The sediment is poorly sorted because ice cover prevents wave action and removal of the fine material to deeper water. Mud derived largely from the suspended loads of rivers, settles slowly in the central part of the lake. Faint laminae in the shelf sands may be varves, but the deep water mud is structureless. Evidently seasonal sedimentary variations do not affect the center of the lake, probably because ice cover minimizes transporting currents. The oxidation-reduction boundary in the sediment is at 5-20 cm, deeper than in temperate lakes, because of oxidation at the lake bottom and slower reduction within the sediment. (Knapp-USGS)
W69-07947

CHEMICAL CHANGES IN INTERSTITIAL WATERS FROM CONTINENTAL SHELF SEDIMENTS,
Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.; and Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Geology.
Gerald M. Friedman, Burton P. Fabricand, Eugene S. Imbimbo, Mary E.Brey, and John E. Sanders.
Work supported by Office of Naval Research. J Sediment Petrol, Vol 38, No 4, pp 1313-1319, Dec 1968. 7 p, 2 fig, 3 tab, 19 ref. Contract No. Nonr-266 (84)ONR.

Descriptors: *Water chemistry, *Sediments, Atlantic Coastal Plain, Continental shelf, Diagenesis, Magnesium, Calcium, Potassium, Chlorides, Membrane processes, Ion exchange, Clays, Sands, Salinity, Equilibrium.
Identifiers: Continental shelf sediments.

Chemistry of pore waters from cores from the inner and outer shelf off Long Island, New York was compared with that of the overlying sea waters. Cores from the inner shelf consist of clean sands, whereas those from the outer shelf contain mud. In both types, the chlorinity and the Ca/Cl, K/Cl, and Rb/Cl ratios are higher in the interstitial waters than in the overlying waters. The Mg/Cl and Li/Cl ratios are about the same, but Li/Cl ratios are higher on the inner shelf than on the outer shelf. The Sr/Cl ratio is highest for the surface waters, lowest for the interstitial waters, and of intermediate values in bottom waters. Values of pH and Eh are lower in the core waters than in the overlying waters. The decreases in pH and Eh below the water/sediment interface are attributed to the activity of anaerobic bacteria. The reasons for the other chemical changes may result from diagenetic changes. Clays may act as semipermeable membranes during compaction and retain salt while expressing less saline water. This does not seem applicable to the clean sands of the inner shelf. The increase of Ca/Cl ratio may be a result of dissolution of aragonite from shells in the enclosing sediments. If true, it is surprising that the Sr/Cl ratio decreases as the Ca/Cl ratio increases. The increase in the K/Cl and Rb/Cl ratios may result from the dissolution of K-feldspar. (Knapp-USGS)
W69-07948

URANIUM DISTRIBUTION IN ARAL SEA SEDIMENTS,
Akademiya Nauk SSSR. Institut Okeanologii.
A. V. Kochenov, and G. N. Baturin.
Engl edition of Akad Nauk, SSSR, transl by Amer Geophys Union, Wash, DC. Oceanology, Acad Sci of USSR, Vol 7, No 4, pp 484-487, 1967. 4 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Lake beds, *Uranium radioisotopes, *Sediments, Water chemistry, Sands, Clays, Mud, Silts, Carbonates, Carbon, Estuarine environment, Detritus, Organic matter, Salinity.
Identifiers: *Russia, Aral Sea Sediments, Uranium bearing sediments.

Uranium distribution in the Aral Sea sediments was investigated by using samples collected in August to October 1965 and earlier publications. The Aral Sea, which is a shallow basin of mean depth of about 20 m, receives its water and minerals from the Amu Dar'ya and Syr Dar'ya Rivers, with the greater part of the sediments of the sea derived from the suspended matter of these rivers. The least uranium content (0.0001-0.0002%) is found in the sands and silty ooze of the coastal zone and is increased to 0.01% in the calcareous and argillaceous sediments of the central area of the basin. The distribution of uranium in the water over the sea area is uneven, varying from 0.00003-0.000035 g/l in the river estuaries to 0.00005-0.00006 g/l in the central part of the sea. It is of interest to note the sediment: lake water uranium content ratio which varies from 1:200 to 1:300, an extremely low ratio. (Gabriel-USGS)
W69-07977

RECENT SEDIMENTATION CONDITIONS IN THE ILE SAINT PAUL LAGOON,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02H.
W69-07978

A CRITICAL REVIEW OF CONVENTIONAL BED LOAD FORMULAE,
Universityof Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
John G. Herbertson.
J Hydrol, Vol 8, No 1, pp 1-26, May 1969. 26 p, 6 fig, 3 tab, 29 ref, append.

Descriptors: *Sediment transport, *Bed load, *Reviews, Suspended load, Simulation analysis, Mathematical models, Bibliographies, Synthetic hydrology, Mathematical studies, Channel morphology, Particle shape, Particle size.
Identifiers: *Similitude theory.

Certain of the conventional forms of bed load formulae are examined using similtude theory as a common basis of comparison. The particular form of similitude theory employed is the method of synthesis presented recently for sediment transport studies by Barr and Herbertson. It is emphasised that any bed load formula is at best an approximation due to the arbitrary nature of the subdivision of total sediment load into wash, suspended and bed load fractions. The particular formula chosen for examination are considered to be representative of bed load formula in general. It is shown that the formula are based on alternative forms of general similitude sediment transport equations and consist of incomplete versions of these equations. Most commonly omitted are terms such as the ratio of sediment to fluid density and the ratio of a linear channel dimension, say flow depth, to sediment grain size. This effectively limits the applicability of the formula to very narrow bands without which there can be little justification for comparison of results obtained by use of the formula. (Knapp-USGS)
W69-08003

SOME ECONOMIC ASPECTS OF URBAN SEDIMENTATION,
Resources for the Future, Inc., Washington, D. C.
For primary bibliographic entry see Field 04C.
W69-08110

2K. Chemical Processes

SOLUBILITY OF GYPSUM IN AQUEOUS ELECTROLYTES AS AFFECTED BY ION ASSOCIATION AND IONIC STRENGTHS UP TO 0.15M AND AT 25 DEG C,
California Univ., Davis. Dept. of Water Science and Engineering.
Kenneth K. Tanji.
Environ Sci and Technol, Vol 3, No 7, pp 656-661, July 1969. 6 p, 2 fig, 4 tab, 40 ref. Grant No. FR 00009 (NIH).

Descriptors: *Solubility, *Gypsum, *Computer programs, Aqueous solutions, Water chemistry, Ions, Electrolytes, Equilibrium, Solutes, Saline water systems, Arid lands.
Identifiers: FORTRAN program, Gypsum solubility.

A computer program was developed to calculate ion association and solubility of gypsum in aqueous solutions of Na, Mg, Ca, Cl, and sulfate at 25 deg C and low ionic strength. The FORTRAN program uses nonequilibrium ionic concentrations as input and calculates Debye-Huckel theory, solubility constant of gypsum, and dissociation constants of calcium sulfate, magnesium sulfate, and sodium sulfate ion to predict equilibrium concentrations. Predicted values agree well with observed values. (Knapp-USGS)
W69-07700

CHEMICAL EQUILIBRIA AND ZONING OF SUBSURFACE WATER FROM JACHYMOV ORE DEPOSIT, CZECHOSLOVAKIA,
Geological Survey of Czechoslovakia, Prague.
For primary bibliographic entry see Field 05G.
W69-07703

CHEMICAL PROPERTIES OF GROUND WATER AND THEIR CORROSION AND ENCRUSTATION EFFECTS ON WELLS,
Geological Survey, Washington, D. C.
Ivan Barnes, and Franke E. Clarke.
Geol Surv Prof Pap 4898-D, 1969. 58 p, 27 fig, 7 tab, 47 ref, 2 append.

Descriptors: *Water chemistry, *Water quality, *Water wells, *Well screens, *Fouling, Chemical potential, Corrosion, Well casings, Aquifers, Chemical reactions, Equilibrium, Corrosion control, Groundwater.
Identifiers: *Egypt, *West Pakistan, *Nigeria, Encrustation effects.

Well waters in Egypt, Nigeria, and West Pakistan were studied for their chemical properties and corrosive or encrusting behavior. From the chemical composition of the waters, reaction states with reference to equilibrium were tested for 29 possible coexisting oxides, carbonates, sulfides, and elements. Of the 29 solids considered, only calcite, calcium carbonate, and ferric hydroxide showed any correlation with the corrosiveness of the waters to mild steel (iron metal). All 39 of the waters tested were out of equilibrium with iron metal, but those waters in equilibrium or supersaturated with both calcite and ferric hydroxide were the least corrosive. Supersaturation with other solid phases apparently was unrelated to corrosion. A number of solids may form surface deposits in wells and lead to decreased yields by fouling well intakes or increasing friction losses in casings. Calcite, hausmannite, manganese spinel, three iron sulfides, copper hydroxide, and manganese hydroxide, were all identified in the deposits sampled. Of geochemical interest is the demonstration that simple stable equilibrium models fail in nearly every case to predict compositions of water yielded by the wells studied. Only one stable phase (calcite) was found to exhibit behavior approximately predictable from stable equilibrium considerations. (Knapp-USGS)
W69-07729

QUALITY OF SURFACE WATERS FOR IRRIGATION IN WESTERN STATES--1964.
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 03F.
W69-07732

EFFECTS OF GAMMA RADIATION ON ACCUMULATION OF MINERAL NITROGEN IN FRESH SOILS,
United Kingdom Atomic Energy Authority, Wantage (England). Research Group.
For primary bibliographic entry see Field 05G.
W69-07825

PROTISTS, PIGMENTS, AND PHOTOSYNTHESIS,
Brandeis Univ., Waltham, Mass. Dept. of Biology.
For primary bibliographic entry see Field 05A.
W69-07836

INTERACTING EFFECTS OF GAMMA RADIATION AND SODIUM HALIDE CONCENTRATIONS ON RAINBOW TROUT,
Utah State Univ., Logan. Ecology Center.
For primary bibliographic entry see Field 05C.
W69-07849

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE SAN ANTONIO RIVER BASIN, TEXAS,
Geological Survey, Austin, Tex.
Jack Rawson.
Tex Water Develop Board Rep No 93, Apr 1969. 24 p, 9 fig, 6 tab, 25 ref.

Descriptors: *Water quality, *Water chemistry, *Texas, Streamflow, Data collections, Sampling, Chlorides, Sodium, Salts, Water pollution, Water sources.
Identifiers: *San Antonio River (Tex).

The kinds and quantities of minerals dissolved in surface waters of the San Antonio River basin are related principally to the geology of the area and to rainfall and streamflow characteristics. Municipal and industrial wastes have degraded the natural quality of water in some streams. Rocks exposed in the basin range in age from Cretaceous to Quaternary. The upper part of the basin is underlain by the Edwards and associated limestones and Glen Rose Limestone. Streams that traverse these outcrops usually contain less than 325 mg/l dissolved solids but are very hard. Principal chemical constituents are calcium and bicarbonate. Dissolved-solids content of water in the lower reach of Medina River averages more than 325 mg/l because of municipal and industrial pollution. The chemical composition of water in streams that traverse younger formations in the central and lower part of the basin is variable. However, the dissolved-solids content of most streams not appreciably affected by pollution averages less than 200 mg/l. Water in these streams usually is moderately hard. Although the chemical quality of water in the mainstem San Antonio River and the lower reach of Cibolo Creek is being degraded by municipal, industrial, and irrigation wastes, the discharge-weighted concentration of dissolved solids in both streams averages less than 500 mg/l. Water in both streams usually is very hard. The chloride content of surface waters in the basin generally averages less than 20 mg/l, except in areas where the chemical quality is being degraded considerably by pollution. The concentration of chemical constituents in surface waters throughout much of the basin is within limits recommended by the U.S. Public Health Service for domestic use. The waters also are suitable for most irrigation uses; however, the water throughout much of the basin is moderately hard or very hard and will require softening for most industrial uses. (Knapp-USGS)
W69-07927

CHEMICAL CHANGES IN INTERSTITIAL WATERS FROM CONTINENTAL SHELF SEDIMENTS,
Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.; and Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W69-07948

UTILIZATION OF THE ANALOG COMPUTER FOR SIMULATING THE SALINITY FLOW SYSTEM OF THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02E.
W69-07957

URANIUM DISTRIBUTION IN ARAL SEA SEDIMENTS,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02J.
W69-07977

THE OCEANIC SIGNIFICANCE OF RIVER ION DISCHARGE,
Gidrometeorologicheskii Institut, Leningrad (USSR).
For primary bibliographic entry see Field 02L.
W69-07980

CARBONATE EQUILIBRIA AND RADIOCARBON DISTRIBUTION RELATED TO GROUNDWATER FLOW IN THE FLORIDAN LIMESTONE AQUIFER, USA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02F.
W69-07985

SILICATE REACTIONS--A REVIEW,
Bureau of Mines, Bartlesville, Okla.
A. G. Collins, and Lillie R. Fisher.
Office Saline Water Res and Develop Progr Rep No 307, 1969. 99 p, 2 index. OSW 14-01-0001-1146.

Descriptors: *Water chemistry, *Silicates, *Chemical reactions, *Reviews, *Bibliographies, Corrosion control, Diagenesis, Weathering, Hydration, Aqueous solutions, Saline water, Fresh water, Chemical analysis.
Identifiers: Silicate chemistry.

Recent literature on silicate-water reactions is reviewed and a bibliography indexed by author and title is compiled. Subjects covered in detail include analytical techniques, buffering in aqueous solution, diagenesis and weathering, hydrothermal reactions in saline and nonsaline media, and corrosion prevention. (Knapp-USGS)
W69-08022

HYDRODYNAMIC STUDIES FOR ELECTRODIALYSIS,
McDonnell-Douglas Astronautics Co., Newport Beach, Calif.
For primary bibliographic entry see Field 03A.
W69-08114

2L. Estuaries

A RECONNAISSANCE STUDY OF THE CHESAPEAKE BAY,
Regional Planning Council, Baltimore, Md.
For primary bibliographic entry see Field 05G.
W69-07742

TRACER STUDY OF THE PHOSPHORUS CYCLE IN SEA WATER,
Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography.
For primary bibliographic entry see Field 05B.
W69-07822

SEDIMENT RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY,
Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 05C.
W69-07851

CHLORINATED HYDROCARBON PESTICIDES IN CALIFORNIA BAYS AND ESTUARIES,
California State Dept. of Fish and Game, Menlo Park. Marine Resources Operations.
For primary bibliographic entry see Field 05B.
W69-07920

COASTAL WATERS AND THE NATION,
National Council on Marine Resources and Engineering Development, Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-07923

THE HUMAN ECOLOGY OF COASTAL FLOOD HAZARD IN MEGALOPOLIS,
Toronto Univ. (Ontario), and Clark Univ., Worcester, Mass.
For primary bibliographic entry see Field 06G.
W69-07942

CHEMICAL CHANGES IN INTERSTITIAL WATERS FROM CONTINENTAL SHELF SEDIMENTS,
Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.; and Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W69-07948

MINERAL RESOURCES OF THE WORLD OCEAN.
Geological Survey, Washington, D. C.; Rhode Island Univ., Newport; and Department of the Navy, Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-07973

THE OCEANIC SIGNIFICANCE OF RIVER ION DISCHARGE,
Gidrometeorologicheskii Institut, Leningrad (USSR).
O. A. Alekin.
Eng edition of Akad Nauk, SSSR, transl by Amer Geophys Union, Wash, DC. Oceanology, Acad Sci of USSR, Vol 7, No 4, pp 431-435, 1967. 5 p, 1 fig, 1 tab, 10 ref.

Descriptors: *Water chemistry, *Ion transport, *River flow, *Ocean circulation, Discharge (Water), Land, Chemical analysis, Precipitation (Atmospheric), Salt balance, Sodium, Potassium, Calcium, Chlorine, Ions, Water temperature, Calcium carbonate, Saturated flow, Hydrostatic pressure.
Identifiers: Oceanic river, Ion discharge.

Salt balance and river ion discharge were investigated on the basis of earlier publications and the data recorded by the Research Vessel Yu. M. Skokal'skiy. The data shows that the amount of ion discharge from the continents into the ocean is 2,310 million tons a year when hydrocarbonate ions are expressed in the form of carbonate ions, or 3,171 million tons a year when they are expressed in terms of bicarbonate ions. This quantity comprises only the 7 principal ions: Cl ion, sulfate ion, bicarbonate ion, Na ion, K ion, Mg ion, and Ca ion, if the amount of water discharged by the rivers into the ocean is assumed to be 35,560 cu km per year. The study of the oceanic ion exchange, precipitation, and saturation processes shows that the oceanic water can be subdivided in depth into 4 zones which, to some extent, are characterized by their own ion contents and exhibit their own saturation and particle dissolution processes. (Gabriel-USGS)
W69-07980

A SYMPOSIUM ON ESTUARINE FISHERIES.
American Fisheries Society, Washington, D. C.

Roland F. Smith, Chairman. Amer Fish Soc Spec Publication No 3, Proc 94th Annu Meeting, Sept

1964, Atlantic City, N J, 1966. 154 p, 21 fig, 10 plate, 21 tab, 386 ref.

Descriptors: *Estuarine fisheries, *Estuaries, *Fisheries, *Ecology, Stream fisheries, Nutrients, Productivity, Water pollution effects, Water pollution control, Pesticides, Water management (Applied), Pollution abatement.
Identifiers: Estuary fisheries symposium.

Estuarine fisheries are discussed in a symposium of 15 papers in the fields of the estuarine ecosystem, the habitat for fishery organisms, man's impact on estuaries, and fishery management. Manmade and natural estuarine ecologic problems and their solutions are discussed from the points of view of several specialties including ecology, sports fisheries, commercial fisheries, shell fisheries, water pollution control, water resources management, and industrial development management. (Knapp-USGS)
W69-07986

A NUMERICAL MODEL FOR THE SIMULATION OF TIDAL HYDRODYNAMICS IN SHALLOW IRREGULAR ESTUARIES,
Texas Univ., Austin. Hydraulic Engineering Lab.
Frank D. Masch, N. J. Schanker, M. Jeffrey, R. J. Brandes, and W. A. White.
Technical Report HYD 12-6901, February 1969. 123 p, 1 tab, 50 fig, 10 ref, 1 append. OWRR Project C-1158. Available from Clearinghouse as PB 184 834 at $3.00 in paper copy and $0.65 in microfiche.

Descriptors: *Estauries, *Mathematical models, Velocity.
Identifiers: *Tidal hydrodynamics, *Tidal amplitudes, Finite difference methods, Net flows, Circulation patterns, Tidal excursions, Tidal prisms, Convective-dispersion transport.

Assuming complete vertical mixing, a two-dimensional time dependent model is described which provides spatial and temporal variations of tidal flows and amplitudes. The model accounts for various physiographic features found in shallow estuaries, variable inflows, low tidal action, and other hydrologic characteristics. The model further provides for the inclusion of wind stress and Coriolis forces. The basic outputs from the model are the time histories of tidal amplitude and velocity in each of two spatial coordinate directions. Data that can be obtained from the model include phase relations, time of flood, ebb, and slack tides, net flows, circulation patterns, tidal excursions, and tidal prisms. The model is designed in such a manner that its basic output serves as directed input to a convective-dispersion model. Although dispersion modeling is not discussed in this report, the interface between these two models is described where appropriate, as the output from the tidal hydrodynamic model is determined in part by the requirements for convective-dispersion or transport models.
W69-08112

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING SALINE IRRIGATION WATER SUPPLIES FOR AGRICULTURE - A CASE STUDY - LOWER COLORADO RIVER BASIN, USA,
Bureau of Reclamation, Denver, Colo.; Bureau of Reclamation, Boulder City, Nev.; and Office of Saline Water, Washington, D. C.
John T. Maletic, Milton S. Sachs, and Elwyn S. Krous.
Pap, Symp Nuclear Desalination, Int At Energy Ag, Madrid, Spain, Nov 1968. 19 p, 4 fig, 7 tab, 12 ref.

Descriptors: *Demineralization, *Irrigation water, *Saline water, Costs, Agriculture, Benefit-cost ratios, Brine disposal, Crops, Field tests, *Electrodialysis, Water treatment, Weather modification, Salt tolerance, Arizona, Economics, Salinity.
Identifiers: *Multistage flash distill, Interbasin water transfer, Crop yield, Lower Colorado River Basin, Irrigation requirement.

A study was performed to evaluate potential applications of multistage flash distillation and electrodialysis processes for desalting saline irrigation water near Yuma, Ariz. The investigation determined the associated costs and benefits and gave benefit-cost ratios. Benefits from desalting are generated by shifts to more profitable cropping patterns, increasing crop yields, reducing water use, reducing costs for water application and drainage, and increasing the flow of farm products. Costs are based on project features such as desalting plants and steam generating equipment, raw water collection facilities, storage reservoirs, conveyance and distribution systems, brine disposal systems, blending facilities, gypsum addition systems, and water treatment facilities. Desalting is expected to find many important applications to agriculture in the near-term future. Competition with other water development possibilities such as interbasin water transfer, weather modification, new salt-tolerant crop varieties, and structural and nonstructural salinity control measures on streams will be involved. (USBR)
W69-07801

MINERAL RESOURCES OF THE WORLD OCEAN.
Geological Survey, Washington, D. C.; Rhode Island Univ., Newport; and Department of the Navy, Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-07973

SILICATE REACTIONS--A REVIEW,
Bureau of Mines, Bartlesville, Okla.
For primary bibliographic entry see Field 02K.
W69-08022

DESALTING,
Office of Saline Water, Washington, D. C.
Joseph J. Strobel.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 114-119, 1967. 6 p, 9 ref.

Descriptors: *Desalination, *Water treatment, *Water costs, Desalination apparatus, Desalination processes, Water supply, Water yield, Water utilization, Saline water, Sea water.
Identifiers: Desalination economics.

Desalting is expected to be an important future source of new freshwater supply. Current technology includes distillation, membranes, crystallization, and ion exchange. Additional research is necessary to lower desalting costs further. Desalting should be considered with other alternatives in development of any incremental water supply program. Current developments are solving technical limitations. Economic possibilities for providing municipal and industrial water are expanding. Future projections of desalting seawater in large plants in the early 1970's are in the range of 22 cents/1,000 gal. and 15 cents or lower after 1975 if predicted low-cost energy is available. Summaries of recent feasibility studies for desalting plants are given and the relation of desalting to pollution is discussed. (Knapp-USGS)
W69-08044

VACUUM FREEZING VAPOR COMPRESSION PROCESS: ONE AND FIVE MILLION GALLON PER DAY DESALTING PLANTS,
Colt Industries, Inc., Beloit, Wis.
R. Consie, R. Darling, D. Emmermann, J. Fraser, and W. Johnson.
Office of Saline Water, Research and Development Progress Report No 451, May 1969. 67 p. OSW 14-01-0001-532.

Descriptors: *Desalination processes, *Freezing, *Cost analysis.
Identifiers: *Vacuum freezing, *Cost studies, *Cost estimates, Direct melting.

Cost studies have been prepared for one and five million gpd vacuum freezing vapor compression desalting plants. These plants use 500,000 gpd factory assembled units in groupings of two and ten to form the desalting plants. Costs for 1 and 5 million gpd plants are 61.5 and 51.3 cents per 1000 gallons respectively. Capital costs of the plants are $1.26 and $1.10 per gallon of daily capacity. The estimated power consumption is 27 KWH/1000 gallons. Fully automatic operation of the plants is assumed thus reducing the labor costs to a minimum. The 500,000 gpd unit is based on the use of a direct melting concept. (Gransee-Office of Saline Water)
W69-08113

HYDRODYNAMIC STUDIES FOR ELECTRODIALYSIS,
McDonnell-Douglas Astronautics Co., Newport Beach, Calif.
G. Belfort, and G. A. Guter.
Office of Saline Water R and D Report No 459, 1969. 144 p. OSW 14-01-0001-1313.

Descriptors: *Desalination, *Electrodialysis, *Membrane process, Hydrodynamics, Screen spacers.
Identifiers: *Desalination apparatus, *Electrochemistry, Solution velocity, Current density.

The hydrodynamic effectiveness of various spacer screens for electrodialysis was studied with the aid of a novel photographic technique in which exposed photographic paper was used in the place of ion-selective membranes, and photographic developer was used in the place of brine. This technique produced a visual record of the membrane-solution interfacial flow patterns in electrodialysis cells. Additional tests were conducted and criteria established for the characterization of each screen with respect to porosity, dead flow area, drag coefficient, and influence on electrical resistance. All of the experimental work was based on the installation of one or more layers of each candidate screen in the open central portion of a 40 mil thick rectangular gasket. The experiments demonstrated that some screens are considerably more effective than others in improving electrodialysis performance, especially at flow rates that give Reynolds numbers greater than 180. Seven (out of 21) of the more promising screens were further evaluated in electrodialysis batch tests to determine how current efficiency, membrane stack pressure drop, and total power requirements vary with flow rate. Two new materials, not previously used in commercial electrodialysis equipment are recommended for further study. (Mintz-Office of Saline Water)
W69-08114

3B. Water Yield Improvement

NATURAL STORAGE TANKS USED TO REFILL THE THAMES RIVER,
Water and Sewage Works, Chicago Ill.
For primary bibliographic entry see Field 04B.
W69-07701

GROUND-WATER RESOURCES OF THE WIND RIVER INDIAN RESERVATION, WYOMING,
Geological Survey, Washington, D. C.
Laurence J. McGreevy, Warren G. Hodson, and Samuel J. Rucker.
Geol Surv Water-Supply Pap 1576-I, 1969. 145 p, 15 fig, 3 plate, 7 tab, 67 ref.

Descriptors: *Water resources, *Groundwater, *Indian reservations, *Wyoming, Aquifers, Geolo-

gy, Water wells, Water quality, Water yield, Recharge, Hydrologic data, Data collections, Water levels, Hydrogeology, Groundwater basins, Water sources.
Identifiers: *Wind River Indian Reservation (Wyo).

The potential yield and quality of water from most rocks in the Wind River Indian Reservation, Wyoming, are poorly known, but estimates may be based on local well data and on data concerning similar rocks in nearby areas. Yields of more than 1,000 gpm are possible from the Ordovician to Pennsylvanian limestones, dolomites, and sandstones. Total dissolved solids range from about 300 to 3,000 ppm. Yields of as much as several hundred gpm are possible from Jurassic and Triassic sandstones. Dissolved solids are generally high. Most wells in Cretaceous rocks yield less than 20 gpm. Dissolved solids range from about 200 to 5,000 ppm. Many parts of the Wind River Irrigation Project have become waterlogged. The relations of drainage problems to geology in the irrigated areas are partly defined by sections drawn on the basis of test drilling. Water from underground storage in alluvium could supplement irrigation water from surface sources in some areas to reduce the need for additional surface-storage facilities as well as to alleviate drainage problems in the irrigated areas. (Knapp-USGS)
W69-07731

WATER RESOURCES OF THE BELLE RIVER BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
W69-07734

EVAPOTRANSPIRATION BY WOODY PHREATOPHYTES,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 02D.
W69-07928

WATER IN KENTUCKY,
Geological Survey, Washington, D. C.
R. A. Krieger, R. V. Cushman, and N. O. Thomas.
Kentucky Geol Surv Ser 10. Spec Publication No 16, 1969. 51 p, 23 fig, 39 photo, 4 tab, 126 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Kentucky, Bibliographies, Water utilization, Water quality, Streamflow, Evaporation, Reservoirs, Climatology, Precipitation (Atmospheric), Runoff, Recharge.
Identifiers: Kentucky water resources.

The water resources, water use, water problems, and water law of Kentucky are discussed in a publication intended for public education to increase knowledge of the nature, availability, and management of water. Data on water quality, water use, streamflow, groundwater level, reservoir capacity and precipitation are tabulated. A bibliography of Kentucky water information is included. (Knapp-USGS)
W69-07943

WATER DISPOSITION IN A STREAM CHANNEL WITH RIPARIAN VEGETATION,
Arizona Agricultural Experiment Station, Tucson; Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center; and Arizona Univ., Tucson. Dept. of Soil Physics.
Hasan K. Qashu, and D. D. Evans.
Soil Sci Soc Amer Proc, Vol 31, No 2, pp 263-269, Mar-Apr 1967. 7 p, 9 fig, 4 tab, 14 ref.

Descriptors: *Riparian water loss, *Riparian plants, *Streamflow, Evapotranspiration, Consumptive use, Transpiration, Storage, Seepage, Banks, Alluvial channels, Specific yield, Water levels.
Identifiers: Streamflow loss.

Water losses along stream channels in the semiarid southwestern United States are of utmost importance when considering water disposition and water yields from a watershed. An analysis is described for estimating the disposition along a reach of a natural stream channel with a riparian vegetation and impermeable bedrock at a shallow depth. Results for one annual cycle are presented which indicate the quantity of water removed from the stream channel reach by various processes. Methods were adapted for the particular set of conditions to measure subsurface water flow and water storage in the channel alluvium. Subsurface water flow was calculated from Darcy's equation. Water storage was estimated from water content, water table elevation, specific yield and volume of alluvium measurements. Four distinct water-use periods were apparent within a yearly cycle, each expressed by a separate water balance equation. Water losses by evapotranspiration were estimated from these equations. For example, 9 mm of water were estimated to be lost per day by transpiration of the riparian vegetation during the months of May and June, a time of water shortage in the area. Total depth of annual water loss by evapotranspiration from the channel reach was estimated to 131 cm of water (4.3 acre-ft/acre). (Knapp-USGS)
W69-07976

WATER 'REQUIREMENTS': THE INVESTMENT DECISION IN THE WATER SUPPLY INDUSTRY,
Manchester Univ., (England).
For primary bibliographic entry see Field 06D.
W69-08097

3D. Conservation in Domestic and Municipal Use

WATER REUSE IN ISRAEL,
Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 05D.
W69-08037

THE ECONOMIST AND THE 'NEW' CONSERVATION,
British Columbia Univ., Vancouver.
Anthony Scott.
Planning 1968, Selected Papers from the ASPO National Planning Conference, San Francisco, pp 277-291, May 4-9, 1968. 15 p, 21 ref.

Descriptors: *Conservation, *Natural resources, Future planning, Economics, Pollution, Industries, Economic impact, Government, Cost-benefit analysis, Demand, Water resources, Finance, Evaluation, Welfare economics.
Identifiers: *Regional planning, Industrial development, Social wealth, Primary beneficiaries, Valuation.

The author admits that conservation may stand in the way of economic development. The possibility of influencing the rate of development was glossed over in the old conservation. The new conservation is concerned with transferring natural products from present uses in favor of different present uses. The tools of economics are inadequate for handling this type of policy. The author assigns to economists with the following tasks: (1) discovering the abstract or theoretical categories within which conservation demands, if they are found to exist, are to be found; (2) measuring the strength of these demands; and (3) comparing conservation demand with developmental demand. The remainder of the article is devoted to an analysis of these suggestions. Thus, although not specifically concerned with water resources, the analysis of economics in conservation should prove useful in the area of water resource development. (Murphy-Rutgers)
W69-08072

3E. Conservation in Industry

CONSERVATION OF WATER BY REUSE IN SOUTH AFRICA,
Council for Scientific and Industrial Research, Pretoria (South Africa).
For primary bibliographic entry see Field 05D.
W69-08031

CONSERVATION OF WATER BY REUSE IN ITALY,
Azienda Acquedotto Municipale di Torina (Italy).
For primary bibliographic entry see Field 05D.
W69-08033

CONSERVATION OF WATER BY REUSE IN MEXICO,
Celulosa y Derivados, S.A., Monterrey (Mexico).
For primary bibliographic entry see Field 05D.
W69-08034

WATER REUSE IN WEST GERMAN INDUSTRY,
Ruhrverband, Essen (West Germany).
For primary bibliographic entry see Field 05D.
W69-08035

THE UTILIZATION OF MUNICIPAL WASTEWATER IN JAPAN,
Ebara-Infilco Co., Tokyo (Japan).
For primary bibliographic entry see Field 05D.
W69-08036

CONSIDERATIONS ON THE REUSE OF WATER IN CERTAIN INDUSTRIES,
Centre Belge d'Etude et de Documentation des Eaux (Liege).
For primary bibliographic entry see Field 05D.
W69-08038

CONSERVATION OF WATER BY REUSE IN THE UNITED STATES,
Celanese Corp. of America, New York.
For primary bibliographic entry see Field 05D.
W69-08039

SUCCESSES AND FAILURES IN WATER REUSE,
Cosden Oil and Chemical Co., Big Spring, Tex.
For primary bibliographic entry see Field 05D.
W69-08051

HISTORY AND POSSIBLE FUTURE OF MULTIPLE REUSE OF SEWAGE EFFLUENT AT THE ODESSA, TEXAS INDUSTRIAL COMPLEX.
Aetron, Covina, Calif.; and El Paso Products Co., Odessa, Tex.
For primary bibliographic entry see Field 05D.
W69-08052

WATER REQUIREMENTS AND USES IN ARIZONA MINERAL INDUSTRIES,
Bureau of Mines, Denver, Colo. Div. of Mineral Resources.
M. M. Gilkey, and Robert T. Beckman.
Bur of Mines Inform Circ No 8162, 1963. 97 p, 51 fig, 8 tab, 8 ref.

Descriptors: *Water utilization, *Arizona, *Mineral industry, Mills, Mining, Water reuse, Water quality, Mine water, Industrial water, Cooling water, Recirculated water.
Identifiers: Metals industry.

The effects of water shortage on Arizona's mineral industries are described. The information was obtained in interviews with company representatives.

Operations covered included all metal mines using substantial quantities of water and all concentrators and smelters. Also included in the survey were 8 operations in the nonmetallic group; 22 in the plating, metal-fabricating, and metal-forming categories; 1 public-utility power company; and 6 water companies. At many operations, inadequacy of the supply necessitated large-scale recirculation. New water from 6 of 21 sources sampled is brackish, and 8 of 11 samples of recirculated water were brackish. Cost of new water from company-owned wells at 14 operations ranged from 1.0 cent per 1,000 gal to 57.7 cents per 1,000 gal, with an average of 12.5 cents per 1,000 gal, including power, labor, and supplies. Recirculation costs for power, labor, and supplies at 3 copper operations ranged from 1.0 cent to 1.8 cents per 1,000 gal. The mineral-product value of copper, lead, zinc, and byproducts is equivalent to $15.27 for each 1,000 gal of new water and $26.29 for each 1,000 gal of consumed water. Thus, a much greater return in product value can be obtained from water used for mineral production rather than for the production of many other commodities. (Knapp-USGS)
W69-08058

3F. Conservation in Agriculture

HYDROLOGIC CONDITIONS IN THE GILA BEND BASIN, MARICOPA COUNTY, ARIZONA,
Geological Survey, Phoenix, Ariz.
R. S. Stulik, and Otto Moosburner.
Ariz State Land Dep Water-Resources Rep No 39, Mar 1969. 63 p, 10 fig, 4 tab, 19 ref.

Descriptors: *Water level fluctuations, *Water resources, *Groundwater, *Surface waters, *Arizona, Irrigation water, Water wells, Data collections, Irrigation, Water supply, Streamflow, Reservoirs, Infiltration, Water yield.
Identifiers: Gila Bend (Ariz), Gila River.

Groundwater from irrigation wells and surface water diverted from the Gila River supply the water used to irrigate about 20,000 acres of cultivated land in the Gila Bend basin. The depth to water ranged from less than 50 to more than 350 ft below the land surface in spring 1966. Changes in water levels vary with the amount and distribution of pumpage. The rate of water-level decline in the Rainbow Valley areas has decreased markedly since 1961, probably in response to decreased pumpage. Near Gila Bend, water levels have declined from 20 to 60 ft since 1953, but in the Citrus Valley area north of Theba, water levels have risen since 1953. In 1965, about 115,000 acre-ft of groundwater was pumped for agricultural use, and 500 acre-ft was pumped for domestic use. Most of the water sampled contained fluoride in excess of the recommended limits. The mean annual surface-water inflow to the Gila Bend basin for the 1960-65 water years was 15,930 acre-ft. During the flood of January 1966, about 407,000 acre-ft of water passed Gillespie Dam, but only about 255,000 acre-ft of water passed Painted Rock Dam. A large part of the flow loss (150,000 acre-ft) probably went into groundwater storage. Well descriptions, water chemical analyses, and driller's logs are tabulated. (Knapp-USGS)
W69-07712

QUALITY OF SURFACE WATERS FOR IRRIGATION IN WESTERN STATES--1964.
Geological Survey, Washington, D. C.

Geol Surv Water-Supply Pap 1960, 1969. 144 p, 2 fig, 1 plate, 18 ref.

Descriptors: *Water quality, *Irrigation water, *Data collections, Water analysis, Surface waters, Salinity, Salt balance, Water chemistry, Water resources.
Identifiers: Irrigations water quality, Western U. S.

Water chemical quality data from 72 irrigation network stations west of the Mississippi River are presented. Each record includes location, a list of available records, extremes, runoff, silica, Ca, Mg, Na, K, bicarbonate, carbonate, sulfate, Cl, F, nitrate, B, total solids, % Na, SAR, specific conductance, and pH. (Knapp-USGS)
W69-07732

PEAK FLOW REQUIREMENTS FOR SPRINKLER IRRIGATION OF ORCHARDS AS AFFECTED BY SOIL TEXTURE AND PEAK EVAPOTRANSPIRATION,
Department of Agriculture, Summerland (British Columbia).
J. C. Wilcox.
Can J Soil Sci, Vol 49, No 1, pp 39-45, Feb 1969. 7 p, 1 fig, 3 tab, 15 ref.

Descriptors: *Sprinkler irrigation, Consumptive use, Duty of water, Orchards, *Soil texture, *Evapotranspiration, *Water requirements, Cover crops, Irrigation efficiency, Bibliographies, Irrigation systems, Field investigations, Climates, Soil moisture, Soil profiles, Evaporation.
Identifiers: *Irrigation requirement, Evaporimeters.

A scheduling procedure was used in 17 orchards from 1962 through 1965 to determine the peak flow of irrigation water required per unit area of land. Irrigation was by the sprinkler method with portable pipe settings of 12 hours. Peak flow was determined on a steady-flow basis during periods of peak evapotranspiration. Evapotranspiration (ET) was determined with evaporimeters. The texture and the water-holding capacity of the soil were also determined. Highly significant coefficients of correlation were obtained between the peak flow required and (1) percent sand, (2) average ET per day during the period of peak ET, (3) depth of water applied at each irrigation, and (4) length of irrigation interval. High correlation coefficients were also obtained among the factors studies. Regression of percent sand and peak ET on peak flow accounted for 90.6% of the variations in peak flow; regression of depth per application and length of irrigation interval accounted for 84.1%. Peak flow was affected directly by the depth of water applied at each irrigation and by the length of the safe irrigation interval, and indirectly by other factors. (USBR)
W69-07780

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 1. INTERPRETATION OF WATER CONTENT AND PRESSURE PROFILES,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W69-07966

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 2. THE WATER BALANCE OF THE ROOT ZONE,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W69-07967

HYDRAULIC PROPERTIES OF A CLAY LOAM SOIL AND THE FIELD MEASUREMENT OF WATER UPTAKE BY ROOTS: 3. COMPARISON OF FIELD AND LABORATORY DATA ON RETENTION AND OF MEASURED AND CALCULATED CONDUCTIVITIES,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W69-08025

ECONOMIC EVALUATION OF PUBLIC IRRIGATION DEVELOPMENT,
Economic Research Service, Washington, D. C.
Clyde E. Stewart.
Economics and Public Policy in Water Resource Development, Ames, Iowa State University Press, 1965, pp 107-126, 20 pp, 2 tab, 5 ref. Edited by S. C. Smith and E. N. Castle.

Descriptors: *Water resources development, *Pricing, *Evaluation, *Irrigation, *Decision-making, River basin, Resources, Value, Budgeting, Measurement, Full employment, Soil classifications, Capital, Land, Reclamation.
Identifiers: *Primary agricultural development, *Price projections, *Residual approach, *Data, *Quantification, Discounting, Opportunity costs, Factor process.

This article points to a basic quantification problem in the description and measurement of physical resources for evaluation purposes. This problem is due to a lack of fully developed soils classification, a lack of availability of measurements of water supplies and efficiencies under farming conditions, and a lack of adequate production functions for various land and water situations. All of these inadequacies place severe initial restrictions on evaluation of water development and use. Although government participation in water resource development helps to fill the inadequacy of the market and pricing system, acceptance of market prices in their entirety may hinge on the goals of government activity; these goals are not yet clearly stated. Procedures and analytical techniques evolve from legislation, and public goals reflected in such legislation may actually be in conflict with over-all decision making in terms of resource investments. Goals specified for a program may not be relevant to a rigid opportunity-cost view of resource alternatives. Apparently, then, quantification for evaluation purposes is modified by purposes and goals. But resource evaluation analysis is an effective screening device and a necessary element in decision-making. (Murphy-Rutgers)
W69-08086

ANALYSIS OF SMALL WATER MANAGEMENT STRUCTURES IN IRRIGATION DISTRIBUTION SYSTEMS,
For primary bibliographic entry see Field 04A.
W69-08117

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FORMATION OF FLOOD PLAIN LANDS,
Army Engineer District, New Orleans, La.
Walter C. Carey.
ASCE Proc, J Hydraul Div, Vol 95, No HY3, Pap No 6574, pp 981-994, May 1969. 14 p, 7 fig, 11 ref.

Descriptors: *Flood plains, *Alluvial channels, *Rivers, *Geomorphology, Sedimentation, Erosion, Meanders, River training, Sediment load, Stream stabilization, Eddies, Turbulence, Streamflow, Deposition (Sediments).
Identifiers: Flood plain formation.

Alluvial rivers migrate laterally and longitudinally and generate new flood plain lands. Lands are formed by sheet accretion, point bar accretion, eddy accretion and back-swamp accretion. The type of flood plain land generated is determined by the nature of the local river migration or movement. With river migration, caving banks are formed, and under certain conditions, the caves can be very sudden, extensive, and dangerous to man in developed or urban areas. (Knapp-USGS)
W69-07707

FLOOD PLAIN INFORMATION-GOODNIGHT ARROYO, DRY CREEK AND WILD HORSE-DRY CREEK, PUEBLO, COLORADO.
Corps of Engineers, Albuquerque, N. Mex.

Corps Eng Flood Plain Rep, April 1969. 52 p, 11 fig, 12 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Colorado, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Pueblo (Colorado), Standard project flood, Intermediate regional flood.

Flooding of the Goodnight Arroyo, Dry Creek, and Wild Horse Creek, Pueblo, Colorado is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07708

FLOOD PLAIN INFORMATION OF ARKANSAS RIVER AND TRIBUTARIES, RUSSELLVILLE AND DARDANELLE, ARKANSAS.
Corps of Engineers, Little Rock, Ark.

Prepared for cities of Russellville and Dardanelle. Corps Eng Flood Plain Rep, Feb 1969. 57 p, 22 fig, 35 plate, 15 tab.

Descriptors: *Floods, *Flood damage, *Arkansas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Russellville (Ark), Dardanelle (Ark), Standard project flood, Intermediate regional flood.

Flooding of the Arkansas River, Russellville and Dardanelle, Arkansas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07715

FLOOD PLAIN INFORMATION OF SWEETWATER RIVER, SAN DIEGO COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.

Corps Eng Flood Plain Rep, Feb 1969. 33 p, 12 fig, 20 plate, 6 tab. Prepared for San Diego County.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: San Diego County (Cal), Standard project flood, Intermediate regional flood.

Flooding of the Sweetwater River, San Diego County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07716

FLOOD PLAIN INFORMATION OF CANY CREEK IN VICINITY OF JACKSON, MISSISSIPPI.
Corps of Engineers, Mobile, Ala.

Prepared for Jackson Planning Board. Corps Eng Flood Plain Rep, Feb 1969. 34 p, 6 fig, 11 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *Mississippi, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Jackson (Miss), Standard project flood, Intermediate regional flood.

Flooding of Cany Creek, Jackson, Mississippi, is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07717

FLOOD PLAIN INFORMATION OF MASON CREEK AT SALEM, VIRGINIA.
Corps of Engineers, Wilmington, N. C.

Prepared for Roanoke Valley Regional Planning Comm. Corps Eng Flood Plain Rep, Jan 1969. 28 p, 7 fig, 11 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Salem (Va), Standard project flood, Intermediate regional flood.

Flooding of Mason Creek, Salem, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07718

WATER RESOURCES DEVELOPMENT BY THE U. S. ARMY CORPS OF ENGINEERS IN SOUTH DAKOTA.
Corps of Engineers, Omaha, Nebr. Missouri River Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 21 p, 8 photo, 1 map, index.

Descriptors: *Water management (Applied), *South Dakota, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U. S. Army Corps of Engineers projects (S Dak).

U. S. Army Corps of Engineers water resources development projects in South Dakota are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07719

WATER RESOURCES DEVELOPMENT BY THE U. S. ARMY CORPS OF ENGINEERS IN NORTH CAROLINA.
Corps of Engineers, Atlanta, Ga. South Atlantic Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 79 p, 2 map, 32 photo, index.

Descriptors: *Water management (Applied), *North Carolina, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U. S. Army Corps of Engineers projects (NC).

U. S. Army Corps of Engineers water resources development projects in North Carolina are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07721

THEORY OF SEEPAGE FROM OPEN CHANNELS.
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab,
For primary bibliographic entry see Field 02G.
W69-07725

TREND-SURFACE ANALYSIS OF THE BASIN AND RANGE PROVINCE, AND SOME GEOMORPHIC IMPLICATIONS,
Geological Survey, Washington, D. C.
Lawrence K. Lustig.
Geol Surv Prof Pap 500-D, 1969. 70 p, 46 fig, 1 tab, 58 ref.

Descriptors: *Geomorphology, *Drainage patterns (Geologic), Drainage density, River basins, Erosion, Geologic control, Hydrogeology, Sedimentary basins (Geological), Topography.
Identifiers: *Basin and Range province, Western U. S.

An attempt is made to examine quantitatively the existing regional topographic variations of the Basin and Range province. The area of ranges to total area, range length, range width, range height, range relief, range volume, cumulative length of trends, cumulative deviation of trends, range width to length, range width to height, and range length to height are used for this purpose. Manual contouring, relative-entropy function, Fourier analysis, and trend-surface analysis were used to analyze data. Relief ages are not identical with radiometric dates because radiometric dates do not generally coincide precisely with dates of orogenic activity throughout the Basin and Range region. The present regional topographic variations coincide well with the known distribution of historic and geologic tectonic events and with the distribution of Precambrian and lower Paleozoic outcrops. In general, alluvial fans are more abundant in areas with large average values of range width, length, height, relief, volume, and area of ranges to total area, whereas pediments predominate in those areas where these values diminish. Weathering predominates on the steep mountain fronts, whereas fluvial processes predominate in the drainage basins. It is suggested that regional drainage distinctions are compatible with the topographic, relief age, and fan-pediment distinctions because each is a function of time. The numbers of drainage systems and their order numbers are a function of the range size in the absence of constraints of shape and lithology. Drainage systems should accord with the steady state predicted by stochastic models and by hydraulic principles in the older and smaller ranges of greater tectonic stabili-

ty, but may not yet have achieved this state within the younger and larger ranges. Trend-surface maps provide a basis for examination of such drainage distinctions within the Basin and Range province. (Knapp-USGS)
W69-07730

FLOOD PLAIN INFORMATION ON TIDAL LANDS AND COHANSEY RIVER IN CUMBERLAND COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

Corps Eng Flood Plain Rep, Dec 1968. 61 p, 4 fig, 6 plate, 15 photo, 5 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Cumberland County (NJ), Cohansey River (NJ), Standard project flood, Intermediate regional flood.

Flooding of the tidal lands and Cohansey River, Cumberland County, New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07739

FLOOD PLAIN INFORMATION - TIDAL LANDS AND MAURICE RIVER CUMBERLAND COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

Corps Eng Flood Plain Rep, Dec 1968. 65 p, 16 fig, 9 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Maurice River (NJ), Cumberland County (NJ), Standard project flood, Intermediate regional flood.

Flooding of the Tidal lands and the Maurice River, Cumberland County, New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07740

FLOOD PLAIN INFORMATION-CHARLOTTE AND MECKLENBURG COUNTY-NORTH CAROLINA.
Corps of Engineers, Charleston, S. C.

Prepared for the Charlotte-Mecklenburg Planning Comm. Corps Eng Flood Plain Rep, Oct 1968. 53 p, 17 fig, 42 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *North Carolina, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Charlotte (NC), Mecklenburg County (NC), Standard project flood, Intermediate regional flood.

Flooding of the McAlpine and McMullen Creeks, Charlotte and Mecklenburg County, North Carolina is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07741

DOWNSTREAM CHANGES IN SEDIMENTOLOGICAL PARAMETERS ILLUSTRATED BY PARTICLE DISTRIBUTION FROM A BREACHED ROCKFILL DAM,
Geological Survey, Sacramento, Calif.
For primary bibliographic entry see Field 02J.
W69-07754

THE EFFECT OF WATER DETENTION STRUCTURES ON RIVER AND DELTA MORPHOLOGY,
Colorado State Univ., Fort Collins, Dept. of Civil Engineering; and Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch.
For primary bibliographic entry see Field 02J.
W69-07761

FLOOD PLAIN INFORMATION OF CHARLES RIVER, MEDWAY, MASSACHUSETTS,
Corps of Engineers, Waltham, Mass.

Corps Eng Flood Plain Rep, Aug 1967. 49 p, 10 plate, 13 photo, 4 tab, 32 ref. Prepared for the town of Medway.

Descriptors: *Floods, *Flood damage, *Massachusetts, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Charles River, Medway (Mass), Standard project flood, Intermediate regional flood.

Flooding of the Charles River, Medway, Massachusetts is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07764

FLOOD PLAIN INFORMATION-MANATI RIVER, PUERTO RICO,
Corps of Engineers, Jacksonville, Fla.

Corps Eng Flood Plain Rep, Mar 1967. 31 p, 10 fig, 1 plate, 10 tab, 10 photo, 21 ref, 1 append. Prepared at the request of the Commonwealth of Puerto Rico.

Descriptors: *Floods, *Flood damage, Puerto Rico, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Manati River (Puerto Rico), Standard project flood, Intermediate regional flood.

Flooding of the Manati River, Puerto Rico is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07765

MECHANICAL HARVESTING OF LAKE WEEDS APPEARS PROMISING FOR HALTING AGING PROCESS,
Wisconsin Univ., Madison. University-Industry Research Program.
For primary bibliographic entry see Field 02H.
W69-07815

DAMS AND LAKE WATER LEVELS.
For primary bibliographic entry see Field 06E.
W69-07883

DAMS AND LAKE WATER LEVELS.
For primary bibliographic entry see Field 06E.
W69-07884

LAKE WATER LEVELS.
For primary bibliographic entry see Field 06E.
W69-07885

WATER CONTROL WORKS AND WATER LEVELS.
For primary bibliographic entry see Field 06E.
W69-07886

NELSON V WILSON (SATURATION BY RAISING WATERTABLE CAN CONSTITUTE TAKING OF THE LAND).
For primary bibliographic entry see Field 06E.
W69-07896

DAMS IN DISREPAIR; ACQUISITION BY MUNICIPALITY.
For primary bibliographic entry see Field 06E.
W69-07897

DAMS.
For primary bibliographic entry see Field 06E.
W69-07905

FLOOD PLAIN INFORMATION, COTTONWOOD CREEK, GRAND PRAIRIE AND ARLINGTON, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Corps Eng Flood Plain Rep, Mar 1969. 36 p, 4 fig, 12 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Grand Prairie (Tex), Arlington (Tex), Standard project flood, Intermediate regional flood.

Flooding of Cottonwood Creek, Grand Prairie and Arlington, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07929

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN TEXAS.
Corps of Engineers, Dallas, Tex. Southwestern Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 64 p, 31 photo, 10 map, index.

Descriptors: *Water management (Applied), *Texas, *Water resources development, Navigation, River basin development, Flood control, Mul-

tiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (Tex).

U.S. Army Corps of Engineers water resources development projects in Texas are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07934

WATER RESOURCES DEVELOPMENT IN MISSISSIPPI BY THE U.S. ARMY CORPS OF ENGINEERS.
Corps of Engineers, Vicksburg, Miss. Lower Mississippi Valley Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 52 p, 3 fig, 51 photo, 4 map, index.

Descriptors: *Water management (Applied), *Mississippi, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (Miss).

U.S. Army Corps of Engineers water resources development projects in Mississippi are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07935

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN TENNESSEE.
Corps of Engineers, Cincinnati, Ohio. Ohio River Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 51 p, 22 photo, 3 map, index.

Descriptors: *Water management (Applied), *Tennessee, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (Tenn).

U.S. Army Corps of Engineers water resources development projects in Tennessee are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07936

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN WEST VIRGINIA.
Corps of Engineers, Huntington, W. Va. Ohio River Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 69 p, 22 photo, 1 map, 2 tab, index.

Descriptors: *Water management (Applied), *West Virginia, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (W Va).

U.S. Army Corps of Engineers water resources development projects in West Virginia are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07937

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN SOUTH CAROLINA.
Corps of Engineers, Atlanta, Ga. South Atlantic Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 45 p, 26 photo, 1 map, 2 tab, index.

Descriptors: *Water management (Applied), *South Carolina, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (SC).

U.S. Army Corps of Engineers water resources development projects in South Carolina are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07938

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN WASHINGTON.
Corps of Engineers, Portland, Oreg. North Pacific Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 100 p, 3 fig, 32 photo, 1 map, index.

Descriptors: *Water management (Applied), *Washington, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (Wash).

U.S. Army Corps of Engineers water resources development projects in Washington are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07939

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN WYOMING.
Corps of Engineers, Omaha, Nebr. Missouri River Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 14 p, 4 fig, 6 photo, 1 map.

Descriptors: *Water management (Applied), *Wyoming, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (Wyo).

U.S. Army Corps of Engineers water resources development projects in Wyoming are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-07940

DETERMINATION OF THE QUANTITY OF WATER TO BE STORED BY DIGITAL COMPUTERS,
Institute of Research of the Hydraulic Resources, Budapest (Hungary).
J. Deri.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 152-160, 1968. 9 p, 3 fig, 3 ref.

Descriptors: *Mathematical models, *Synthetic hydrology, *Digital computers, *Water utilization, *Water supply, Optimization, Systems analysis, Stochastic processes, Statistical models, Water management (Applied), Risks, Forecasting.
Identifiers: Hungary.

Because both the water needs of water users and the utilizable water resources are stochastic variables, water needs can be satisfied only at a certain probability. The surplus and the shortage of water are also stochastic variables. By using the well-known methods of mathematical statistics the quantity of water resources to be stored for the users can be determined so that the expected annual operating costs including costs of the surpluses and shortages would be the minimum. A method is introduced to determine the optimum water resources to be stored for the users if costs of the unit quantities are not of stochastic character. After a comparison between the calculated and actually available reserves in every year a more rational utilization of water resources or direction of the process of utilization will be possible. The method can be applied to both simple and complicated catchment areas. In simple cases the problem can be solved manually, but in most cases the application of digital computers is needed. Digital computers may decisively contribute to the development of the method of operations research and activity analysis in the field of water management for the sake of better utilization of resources. (Knapp-USGS)
W69-07960

FLOOD PLAIN INFORMATION, CHICKAHOMINY RIVER WEST OF BOTTOMS BRIDGE, HENRICO COUNTY, VIRGINIA.
Corps of Engineers, Norfolk, Va.

Corps Eng Flood Plain Rep, Dec 1968. 35 p, 5 fig, 14 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Chickahominy River (Va), Henrico County (Va), Standard project flood, Intermediate regional flood.

Flooding of the Chickahominy River, Henrico County, Virginia is described in a report of flood

plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07961

FLOOD PLAIN INFORMATION, NEW RIVER, CHANEY, MILL, AND BLUE CREEKS, JACKSONVILLE, NORTH CAROLINA.
Corps of Engineers, Wilmington, N. C.

Corps Eng Flood Plain Rep, Dec 1968. 57 p, 14 fig, 13 plate, 17 tab.

Descriptors: *Floods, *Flood damage, *North Carolina, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Jacksonville (NC), Standard project flood, Intermediate regional flood.

Flooding in Jacksonville, North Carolina is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these appraoches. (Knapp-USGS)
W69-07962

FLOOD PLAIN INFORMATION OF MUD RIVER IN VICINITY OF MILTON, WEST VIRGINIA.
Corps of Engineers, Huntington, W. Va.

Corps Eng Flood Plain Rep, June 1968. 39 p, 15 fig, 16 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *West Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Milton (W Va), Standard project flood, Intermediate regional flood.

Flooding of the Mud River, Milton, West Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07963

FLOOD PLAIN INFORMATION REPORT ON DELAWARE RIVER, BUCKS COUNTY, PENNSYLVANIA.
Corps of Engineers, Philadelphia, Pa.

Corps Eng Flood Plain Rep, July 1967. 60 p, 5 fig, 9 plate, 7 photo, 8 tab, append.

Descriptors: *Floods, *Flood damage, *Pennsylvania, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Delaware River, Bucks County (Pa), Standard project flood, Intermediate regional flood.

Flooding of the Delaware River, Bucks County, Pennsylvania is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-07975

STAGES AND DISCHARGES OF THE MISSISSIPPI RIVER AND TRIBUTARIES IN THE ST. LOUIS DISTRICT, 1965.
Corps of Engineers, St. Louis, Mo.

Corps Eng Basic Data Rep, 1966. 139 p, 1 map, 2 tab, index.

Descriptors: *Discharge (Water), *Mississippi River, *Data collections, *Missouri, Streamflow, Stage-discharge relations, Hydrologic data, Stream gages, Discharge measurement.
Identifiers: St. Louis (Mo).

The results of stage and discharge measurements made on the Mississippi River and its tributaries, principally in the St. Louis District, during the 1965 Calendar Year are tabulated. The data comprise a brief station description, a tabulation of daily stages and, where determined, mean daily discharges. A total of 95 stations are included. Data for 12 stations were furnished by other districts or other Government agencies. Twelve gages were established and 3 were discontinued during the year. The gage readings are water-surface elevations expressed in feet with reference to a zero elevation referred to mean sea level. The datum used is that of the 1929 General Adjustment. The time of gage readings is expressed in Central Standard Time. The river mileage as listed for each station on the Mississippi River is measured from the confluence of the Mississippi and Ohio Rivers; for tributary stations, from the mouth of the respective tributary. (Knapp-USGS)
W69-07988

THE INFLUENCE OF AQUATIC VEGETATION ON RIVER DISCHARGE,
State Inst. of Hydrology and Meteorology, Warsaw (Poland).
Zbigniew Pastawski.
Available from Clearinghouse as TT-67-56053 at $3.00 in paper copy. Wiad Sluzby Hydrol i Meorol, Vol 2, No 54, 1963. 39 p, 41 fig, 7 tab, 73 ref.

Descriptors: *Stage-discharge relations, *Aquatic plants, Channels, Discharge coefficients, Discharge (Water), River forecasting, Streamflow forecasting, Hydraulics, Hydrographs, Runoff, Stream erosion.
Identifiers: Poland.

The effects of aquatic vegetation on the stage-discharge relations of rivers is discussed. River plants regulate flow, prevent channel erosion, and facilitate ice-cover removal. European methods of calculating vegetation effect on river stages are reviewed. Results of correlation analyses of observations of Polish streams affected by vegetation are tabulated and shown graphically. (Knapp-USGS)
W69-07989

A STUDY OF THE SPECIFIC YIELD IN LAND-DRAINAGE SITUATIONS,
Agricultural Research Council, Cambridge (England). Unit of Soil Physics.
A. G. Dos Santos, Jr, and E. G. Youngs.
J Hydrol, Vol 8, No 1, pp 59-81, May 1969. 23 p, 11 fig, 24 ref.

Descriptors: *Specific yield, *Soil water, *Drainage, Gravitational water, Porosity, Permeability, Specific retention, Water storage, Percolation, Infiltration, Aquifers.
Identifiers: Soil air content.

From the definition of the specific yield in an unconfined aquifer, it is shown that the true specific yield is a function of the horizontal position and time and may be obtained from the measurements of localized fluxes and localized water-table movements. With the assumption of vertical flow above the water table, the specific yield is derived as the sum of the air content at the surface and the ratio of the rate of change of the volume of water held in the moisture profile above the water table to the rate of rise or fall of the water table. Since the latter ratio can be small in certain circumstances, the air content at the surface by itself is often a fair approximation to the specific yield. Results of measurements of all the specific yields, obtained in non-steady state drainage experiments using a completely permeable drain installation and a plastic drain installation in a hydraulic model sand tank, are presented. With the use of a virtual specific yield given by the air content at the surface in the midplane position between drain lines, calculated assuming steady state conditions with a stationary water table height and drain discharge for a given drain installation, rise and decay curves for the water table are calculated and compared with experiment, and fair agreement found. (Knapp-USGS)
W69-08005

A STOCHASTIC MODEL OF MONTHLY RESERVOIR STORAGE,
City Univ., London (England).
C. Venetis.
Water Resources Research, Vol 5, No 3, pp 729-734, June 1969. 6 p, 14 ref.

Descriptors: *Markov processes, *Stochastic processes, Reservoirs.
Identifiers: *Stochastic model, *Monthly reservoir storage, Autoregressive process, Markov Chain, Normality.

In this paper the reservoir inputs are assumed to be generated by a stochastic process. It is further assumed that the autoregressive process (continuous state space) can be adequately approximated by a finite Markov chain. The reservoir content will be treated as a finite Markov chain, conditional and nonhomogeneous. An expression giving the limiting distribution for each month is derived. It is noted that normality of the process is not essential to the model. A simple numeric example illustrates the application of the theory of monthly storage to practical problems. (Loeb-Rutgers)
W69-08062

ANALYSIS OF SMALL WATER MANAGEMENT STRUCTURES IN IRRIGATION DISTRIBUTION SYSTEMS,
Gaylord V. Skogerboe, Wynn R. Walker, Brent B. Hacking, and Lloyd H. Austin.
Research Project Summary Technical Completion Report WG-55-1, June, 1969. 38 p, 150 ref. Utah State University, Logan, Utah Water Research Laboratory. OWRR Project B-012-UTAH.

Descriptors: Hydraulic design, *Hydraulic structures, *Irrigation design, *Water distribution (Applied), Hydraulics, Irrigation engineering, Irrigation systems.

The Irrigation and Drainage Research Conference conducted at Utah State University (ASCE, 1964) delineated many of the research needs regarding 'Small Low-Cost Hydraulic Structures for Conveyance and Distribution Systems,' which was one of the six topics considered at the conference. In discussing possibilities for accomplishing the recommended research, it was suggested by some panel members that a considerable portion of the work could be undertaken by graduate students, particularly at the Master of Science level. The intent of this report has been to sort through the large volume of literature in an attempt to define the specific research needs regarding small water management structures used in irrigation distribu-

tion systems. In particular, the emphasis has been to develop specific research topics which could be accomplished as a thesis by a graduate student at the Master of Science level.
W69-08117

DEVELOPMENT OF DRAINAGE ASSESSMENT PROCEDURES BASED ON PHYSICAL FEATURES IN ILLINOIS,
Illinois Univ., Urbana. Water Resources Center.
Benjamin A. Jones, Jr., and Carroll J. W. Drablos.
Research Report No 19, Water Resources Center, University of Illinois, May 1969, vi+ 27 p, 3 fig, 4 tab, 33 ref. OWRR Project A-011-ILL.

Descriptors: *Drainage, *Assessments, *Benefits, Drainage districts.
Identifiers: Physical features.

The objectives of this study were to identify the physical features of the land in a drainage district which influence benefits accruing from drainage improvements, and to formulate a method for distributing assessments based upon the relative importance of these physical features. The significant physical features discovered on the study were: (1) the distance from the tract of land to the main drain, (2) the distance from the tract of land to the main outlet, and (3) the permeability of the soil on the tract of land. An equation was developed to determine the assessment for any tract: An= 1.4845 - 0.3476 (Ln/L*) - 0.4680 (Dn/D*) 0.4434 Kn/K*). The equation provides a procedure to equitably distribute drainage assessments with a savings in time. This unbiased procedure should reduce the present objection of landowners of unfair assessments based upon personal judgment. Although the present equation is limited to the geographic area that supplied the data for the coefficients, the procedure developed may be used to calculate coefficients for other soil and morphological areas. (Betchart-Univ of Ill)
W69-08124

4B. Groundwater Management

NATURAL STORAGE TANKS USED TO REFILL THE THAMES RIVER,
Water and Sewage Works, Chicago Ill.
F. C. Livingstone.
Water and Sewage Works, Vol 116, No 6, pp 208-212, June 1969. 5 p, 4 fig, 1 tab.

Descriptors: *Low-flow augmentation, *Regulation, *Boreholes, Waste dilution, Water allocation (Policy), Water distribution (Applied), Groundwater, Water wells, Recharge, Water levels, Pumping, Water yield, Water storage, Storage tanks.
Identifiers: Thames River (England).

A plan is proposed to supplement the low flow of the Thames River, England with groundwater pumped from chalk beds in the Thames Basin. It is calculated that 340 mgd may safely be withdrawn from 248 wells, which can be drilled at a total cost of less than $20 million. The average annual rainfall in the Thames catchment is 28.84 inches, and in the period of record it has varied from 17.8 in. to 40.8 in. Annual runoff averages 9.6 in. Test holes and aquifer tests show that the amount of water available is enough to increase summer low flow to significantly reduce pollution, and groundwater levels will be lowered enough to increase winter wet period infiltration to greatly reduce high flows. (Knapp-USGS)
W69-07701

HYDROLOGIC CONDITIONS IN THE GILA BEND BASIN, MARICOPA COUNTY, ARIZONA,
Geological Survey, Phoenix, Ariz.
For primary bibliographic entry see Field 03F.
W69-07712

AN APPRAISAL OF THE GROUND-WATER RESOURCES OF THE SUSQUEHANNA RIVER BASIN IN NEW YORK STATE,
Geological Survey, Washington, D. C.
Este F. Hollyday.
Geol Surv Open-file Rep, Mar 1969. 52 p, 5 fig, 5 tab, 20 ref.

Descriptors: *Water resources, *Groundwater, *New York, Aquifers, Glacial drift, Water wells, Water quality, Water yield, Recharge, Water levels, Groundwater basins, Hydrogeology.
Identifiers: *Susquehanna River Basin (NY).

A survey was made of the groundwater resources of the Susquehanna River Basin in New York. The area's major aquifers are Pleistocence outwash. Yields are as high as 2,000 gpm at a cost of about 5 cents per 1000 gal. The quality of most water from the outwash is excellent. There is no present or foreseeable future water shortage in the basin; local problems may arise because of improper management or well locations. Some water from the bedrock contains excessive iron and chloride concentrations. A few samples of water from outwash contain too much iron, and all groundwater in the area is extremely hard. (Knapp-USGS)
W69-07713

GEOLOGY FOR LAND AND GROUND-WATER DEVELOPMENT IN WAYNE COUNTY, MICHIGAN,
Wayne State Univ., Detroit, Mich.
For primary bibliographic entry see Field 02F.
W69-07728

WATER IN KENTUCKY,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 03B.
W69-07943

CONFINED FRESH WATER AQUIFERS IN LIMESTONE EXPLOITED IN NORTH MEXICO WITH DEEP WELLS BELOW SEA LEVEL,
Office of Hydraulic Resources (Mexico).
For primary bibliographic entry see Field 02F.
W69-07981

THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
Imperial Coll. of Science and Technology, London (England). Dept. of Geology.
P. G. Fookes, and J. L. Knill.
Eng Geol, Vol 3, No 2, pp 81-120, Apr 1969. 40 p, 33 fig, 4 tab, 14 ref.

Descriptors: *Groundwater, *Water wells, *Aquifers, Alluvium, Tunnels, Groundwater basins, Water resources development, Water yield, Water levels.
Identifiers: *Iran, Qanats.

As in most arid environments, the availability and distribution of water in Iran has been the major factor in determining past regional development. The groundwater resources of the basins have been developed for a considerable period of time by the traditional, but very effective, systems of qanats. The futher exploitation of groundwater, therefore, requires careful evaluation of the manner in which modern methods of abstraction can be combined within existing patterns of usage. In those areas marginal to mountainous regions the integrated use of ground and surface water resources may be of considerable importance. Three case histories illustrate different facets of groundwater development in northern Iran grading from mountain to plain environments. In the more central areas, where qanats, tens of kilometers in length, are used to supply isolated desert villages, deep tube wells are replacing this ancient system because of their speed of construction and ease of maintenance. (Knapp-USGS)
W69-08009

4C. Effects on Water of Man's Non-Water Activities

WATER AND METROPOLITAN MAN,
American Society of Civil Engineers, Cambridge, Mass. Urban Hydrology Research Council.
For primary bibliographic entry see Field 06B.
W69-07722

COMPLIANCE WITH ARTICLE SUSPENDED WHERE REQUIRED EQUIPMENT UNOBTAINABLE; ALLOWANCE FOR PLANNING AND INSTITUTING CHANGES.
For primary bibliographic entry see Field 06E.
W69-07879

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
For primary bibliographic entry see Field 06E.
W69-07910

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
For primary bibliographic entry see Field 06E.
W69-07911

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
For primary bibliographic entry see Field 06E.
W69-07912

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
For primary bibliographic entry see Field 06E.
W69-07913

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
For primary bibliographic entry see Field 06E.
W69-07914

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
For primary bibliographic entry see Field 06E.
W69-07915

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO THE EVALUATION ON THE EFFECTS OF URBANIZATION OF THE RUNOFF CHARACTERISTICS OF SMALL WATERSHEDS,
Utah Water Research Lab., Logan.
V. V. Dhruva Narayana, and J. Paul Riley.
Symp on Use of Analog and Digital Computers in Hydrol Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 38-48, 1968. 11 p, 6 fig, 3 tab, 5 ref.

Descriptors: *Analog computers, *Analog models, *Model studies, *Urbanization, *Rainfall-runoff relationships, Hydrographs, Hydrograph analysis, Storm runoff, Paving, Land use, Infiltration.
Identifiers: *Urban hydrology, *Austin (Tex), Waller Creek, Equivalent rural watershed.

In the synthesis of hydrograph characteristics of small urban watersheds, the distribution of the water among the various phases of the runoff process is attempted by the concept of 'Equivalent Rural Watershed'. The criteria for transforming the urban watershed into an equivalent rural watershed require that, for a given input into both the models the outputs must be identical. The hydrograph of

outflow from an urban watershed is obtained by chronologically deducting the losses due to interception, infiltration and depression storage from precipitation on the equivalent rural watershed and then routing it through the surface and channel storages. This is accomplished with the analog computer at the Utah Water Research Laboratory, Utah State University at Logan. Testing and verification is done with rainfall and runoff data from the Waller Creek watershed at Austin, Texas. In the verification process, coefficients representing interception, depression storage and infiltration are determined by trial and error so that the simulated hydrograph is nearly identical to the measured hydrograph of the prototype. The variation in the values of these coefficients from year to year is assumed to be due to the corresponding variations in the characteristics of urbanization defined by the percentage impervious cover and the characteristic impervious length (ratio of the mean length of travel between the center of the impervious area and the discharge measuring point to the maximum length of travel on the watershed. (Knapp-USGS)
W69-07951

SOME ECONOMIC ASPECTS OF URBAN SEDIMENTATION,
Resources for the Future, Inc., Washington, D. C.
Robert K. Davis, and David B. Brooks.
Land Economics, Vol. 43, No. 3, pp 312-319, August 1967. 8 p, 20 ref.

Descriptors: *Third party effects, *Sedimentation, Land development, Rural areas, Economics, Accelerated erosion, Runoff, Sediment control, Strip mines.
Identifiers: *Urban areas, Public control measures.

Offsite effects of sedimentation violate a prime assumption of the pure market system-that each economic actor is accountable for the consequences of his own actions. The problem is considered for both rural and urban areas. Urban sedimentation presents a clear case of third party effects. It is largely caused by accelerated erosion from: (1) the vast exposure of raw soil at construction sites, and (2) the extremely high peak runoff rates caused by the high proportion of roofed and paved land in urban watersheds. A large share of third party losses are damaged recreational and esthetic values. Private economic incentives will not alleviate the problem. There are major gaps in our knowledge of the technical and economic effects of public control measures, gaps that are critical not just for the design of efficient control systems but even for predicting whether sediment reduction will improve or impair water quality. Several alternative public actions are evaluated. The procedures and regulations that coal strip miners must follow in several states suggest an approach for urban land management. Land development should be compatible with the topography and drainage system of a site. (Gossen-Chicago)
W69-08110

4D. Watershed Protection

SEDIMENTATION ENGINEERING CHAPTER VI: ECONOMIC ASPECTS OF SEDIMENTATION,
Thomas Maddock, Jr.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY1, pp 191-207, Jan 1969. 17 p, 30 ref, append.

Descriptors: *Sedimentation, Erosion, *Economic impact, Degradation, Beach erosion, *Deposition (Sediments), Soil erosion, Sediments, Costs, Damages, Estuaries, Alluvial channels, Stable channels, Bibliographies, Erosion control, Hydrology, Turbidity, Navigation, Municipalities, Reservoirs, Aggradation, Agricultural engineering.
Identifiers: Sediment-water relationship.

A recitation of problems connected with the change of movement of water and sediment in stream systems leads to the conclusion that these problems arise as a natural result of the change of the water-sediment regime. Costs of solving the problems should be considered in evaluating benefits occasioned by the original actions. Sometimes cause and effect relations are not understood by decision makers. A method of farming on flatland may be undesirable when applied to sloping ground. Diverting stormflow from city streets to natural watercourses may be harmful. Breaching a power dam filled with sediment will cause filling of channels downstream. Responsibilities of engineers studying the sedimentation problems involved in civil engineering works are threefold: (1) identifying the problem and forecasting the nonbeneficial effects of the solution; (2) designing projects with desirable purposes to mitigate the undesirable effects, and when this is not possible; (3) providing measures for controlling the undesirable reaction to an action for a desired purpose. The engineer is always confronted with the necessity of recognizing the entire problem, preparing a suitable plan for accomplishing a specific purpose, and assessing all costs involved in the plan. (USBR)
W69-07794

CARBONATE TURBIDITES, GULF OF MEXICO,
Texas A and M Univ., College Station. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W69-07945

REWORKING OF GLACIAL SEDIMENTS IN THE NORTHWEST ARM, A FJORD-LIKE INLET OF THE SOUTHEAST COAST OF NOVA SCOTIA,
Smithsonian Institution, Washington, D. C. Div. of Sedimentology.
For primary bibliographic entry see Field 02J.
W69-07946

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

NUCLEAR METHODS IN AIR AND WATER POLLUTION ANALYSIS,
Louisiana State Univ., Baton Rouge.
Frank A. Iddings.
Environ Sci Technol, Vol 3, No 2, pp 132-140, Feb 1969. 9 p, 9 fig, 1 tab, 15 ref.

Descriptors: *Tracers, Radioactivity, *Radioactivity techniques, Air pollution, Radioactive decay, Radiochemical analysis, Radiochemistry, *Radioisotopes, Radiation measurement, *Chemical analysis, Chemistry, Gamma rays, Water analysis, Water pollution, Nuclear meters, Measuring instruments, Instrumentation, Quantitative analysis, Bibliographies.
Identifiers: *Radioactive tracers, Radionuclides, Radiation detectors, Nuclear radiation, Activation analysis.

Nuclear methods are well suited for air and water pollution analyses. Advantages are high sensitivity, specificity, relative freedom from interference, rapid and simple analysis, and low cost. Disadvantages include scarcity of trained technicians, adverse public reaction to nuclear methods, and availability of the proper tracer. Radioactivity and detection devices are summarized. Basic principles and applications are discussed for the following nuclear techniques: isotope dilution, radiorelease, radioisotope derivative analysis, radiometric titration, study of analytical chemistry methods, tracing, radiation absorption, and activation analysis. The brightest prospects for nuclear methods are in chemical analyses method studies and automation of analyses. Limited quantities of radioisotopes are available for studying analytical methods without a specific AEC license. General license quantities of radioactive isotopes are given. (USBR)
W69-07782

EVALUATION OF THE PYRIDINE-ALKALI COLORIMETRIC METHOD FOR DETERMINATION OF ATRAZINE,
Wisconsin Univ., Madison. Dept. of Soils.
R. O. Radke, D. E. Armstrong, and Gordon Chesters.
J Agr Food Chem, Vol 14, No 1, pp 70-73, Jan-Feb 1966. 2 fig, 3 tab, 10 ref. WP 00751-01.

Descriptors: *Colorimetry, *Analytical techniques, *Chemical analysis, *Herbicides, Degradation (Decomposition), Hydrogen ion concentration, Soil chemistry, Temperature, Water chemistry, Water pollution sources.
Identifiers: *Atrazine, Beer's law, 2-chloro-4-ethylamino-6-isopropylamino-s-triazine, 2-chloro-s-triazines, Hydroxtriazine, Perfusion, Propazine, Pyridine-alkali method, Pyridine-alkali-ethyl cyanoacetate method, Semazine.

An evaluation of the pyridine-alkali and pyridine-alkali-ethyl cyanoacetate techniques for the colorimetric determination of atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) showed that color intensity was influenced by the pH of the system and temperature of reaction of the atrazine-pyridine complex with alkali. Color intensity increased with increased acidity and a suitable temperature for color development is 20 plus or minus 2 deg Celsius. The sensitivity of the pyridine-alkali-ethyl cyanoacetate method was 0.02 parts-per-million with a precision of plus or minus 1.5%. Either technique is adaptable to other 2-chloro-s-triazine herbicides. (Armstrong-Wisc)
W69-07821

THE PHYSIOLOGY OF THE COLIFORM GROUP,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
Harold F. Clark, and Paul W. Kabler.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 202-229, 1964. 1 fig, 2 tab, 52 ref, disc.

Descriptors: *Bacteria, *Coliforms, *Pollutants, Sanitary engineering, Water, Foods, Soils, Gases, Hydrogen, Carbon dioxide, Fermentation, Plants, Cattle, Grains (Crops), Biochemistry, Microorganisms, Milk, Acid bacteria, Carbohydrates, Physiochemical properties, Animals, Statistical methods, Birds, Human diseases, Sheep, Geographical regions, United States, Inspection, Spores, Hydrogen sulfide, E coli.
Identifiers: *Physiology, *Bacillus coli, Taxonomy, Health, Aerobacter aerogenes, Feces, Glucose, Morphology, Bacterium coli, Bacterium aerogenes, Motility, Coli communis, B lactes-aerogenes, Sucrose, Lactose, Dulcitol, Raffinose, Mannitol, Methyl, Indole, Tryptophan, Ehrlich reaction, Vibrio cholera, Pigs, Types, Acetylmethyl-carbinol, Citrate, Uric acid, Cellobiose, Liquefaction, Eijkman test.

Although the methodologies for distinguishing between the coliform strains of fecal and non-fecal origin are adequate for pollution, the perfect test has not been developed. The gas ratio (Hydrogen:Carbon dioxide) differential test seemed to solve the problem of differentiating the coliform bacteria of fecal origin from those of plant or soil origin but was unadaptable as a routine method. As laboratory procedure, the methyl red test was recommended as of equal value. Since certain assumptions were not valid, its use as a reference procedure was rejected. The property of producing indole from tryptophan has been extensively applied. The indole reaction by coliform bacteria from feces of warm-blooded animals is generally positive in excess of 90 percent, although approximately one-fifth of the coliform bacteria from unpolluted soils can also produce indole. The Voges-Proskauer test, traditionally used as a taxonomic characteristic, is useful in separating fecal from non-fecal coliform group when the data are interpreted statistically. The citrate utilization

reaction is useful, on a statistical basis, for separating fecal and non-fecal types. The tests, methyl red, indole, Voges-Proskauer, citrate, none entirely satisfactory individually, combined (IMVIC test), yielded the best classification. The elevated temperature test was superior to other procedures in simplicity. (See Vol. 2, No. 18, Field 5C, W69-07423). (Jones-Wisc)
W69-07835

PROTISTS, PIGMENTS, AND PHOTOSYNTHESIS,
Brandeis Univ., Waltham, Mass. Dept. of Biology.
Jerome A. Schiff.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 298-313, 1964. 5 fig, 2 tab, 14 ref, disc.

Descriptors: *Photosynthesis, *Pigments, *Chlorophyll, *Spectrophotometry, *Absorption, *Electron microscopy, Wavelengths, Sun, Light, Plant pigments, Electrochemistry, Plants, Animals, Microscopy, Algae, Thermodynamics, Energy, Ecology, Euglena.
Identifiers: *Protists, Protista, Monera, Chlorella, Scenedesmus, Chlamydomonas, Ulva, Spirogyra, Ochromonas, Nitzschia, Navicula, Coilodesme, Porphyridium, Porphyra, Hemiselmis, Cryptomonas, Cyanidium, Sennia, Tribonema, Monodus, Nitella, Chara, Gonyaulax, Anacystis, Chroococcus, Anabaena, Oscillatoria, Nostoc, Rhodospirillum, Chromatium, Rhodopseudomonas, Chlorobium, Chlorophyll a, Chlorophyll b, Chlorophyll c, Chlorophyll d, Carotenoids, Phycocyanin, Phycoerythrin, Chloroplasts.

Photosynthetic structures of higher plants and photosynthetic bacteria are compared chemically and with both light and electron microscopes. Higher plants, including Protista and Cyanophyta, evolve oxygen during photosynthesis, whereas photosynthesis in bacteria does not involve formation of molecular oxygen. Chlorophyll a has chemical ability to mediate photosynthesis by interacting with other enzymatic cell machinery. The resulting molecule represents a compromise between light-absorbing properties and chemical properties. Accessory pigments with absorption properties different from chlorophyll a, yield fluorescence characteristic of chlorophyll a, and permitting photosynthesis in limited spectrometric regions, increase the amount of energy. This is transferred along a chain of accessory pigments resulting, eventually, in chlorophyll a. Organisms occur ecologically according to their light-absorbing abilities. All photosynthetic organisms seem to have similar systems for the production of adenosine triphosphate and reduced triphosphopyridine nucleotide but differ in the way they obtain extra electrons. Green plants obtain these from a second photochemical reaction involving water, while with photosynthetic bacteria, they arise from externally added hydrogen sulfide, hydrogen, etc. Photosynthetic bacteria employ a somewhat different pigment from green plants, but the matabolic picture appears remarkably similar and the basic outlines are strongly suggested by the experimental data. (See also Vol. 2, No. 18, Field 5C, W69-07423). (Jones-Wisc)
W69-07836

THE METHANE FERMENTATION,
Stanford Univ., Calif. Dept. of Civil Engineering.
Perry L. McCarty.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, New York, pp 314-343, 1964. 6 fig, 2 tab, 28 ref, disc.

Descriptors: *Bacteria, *Biochemistry, *Fermentation, *Methane, Acids, Amino acids, Anaerobic conditions, Carbohydrates, Carbon dioxide, Chemical oxygen demand, Chromatography, Decomposing organic matter, Lagoons, Lakes, Manometers, Microbiology, Ponds, Oxygen, Proteins, Sediments, Septic tanks, Sludge, Spores, Streams, Temperature, Tracers, Waste disposal, Yeasts.
Identifiers: Acetic acid, Clostridium, Methanobacterium formicicum, Methanobacterium proprionicum, Methanobacterium sohngenii, Methanobacillus omelianskii, Methococcus mazei, Methococcus vannielli, Methanosarcina barkerii, Methanosarcina methanica, Proprionic acid, Succinic acid.

Methane fermentation, conversion of organic matter to methane and carbon dioxide, was studied with impure or partially purified cultures. 'Acid formers' convert proteins, carbohydrate, and fats to fatty acids by hydrolysis and fermentation. Then methane-producing bacteria utilize the organic acids, converting them into carbon dioxide and methane. Rates of fermentation are dependent on optimum environmental conditions. Radiocarbon studies indicate that fatty acids are fermented by beta oxidation or a similar mechanism with the methane bacteria solely responsible. Fermentation of propionate may be a limiting factor in methane fermentation from fatty acids and carbohydrates. Tracer studies on overall methane fermentation of various carbohydrates indicate acetic acid formation and carbon dioxide reduction. Complex proteins were first hydrolyzed by bacterial enzymes into simple amino acids, then fermented by various pathways, depending upon the organisms involved. Free energy from methane fermentation of organics is low. Generation time required to double the bacterial population is related to minimum sludge retention time. If sludge retention time is decreased below generation time, bacteria will be wasted faster than they reproduce, resulting in failure of the process. It was found that yeast extract and certain other additions decreased the time required for gas formation. (See also Vol. 2, No. 18, Field 5C, W69-07423). (Jones-Wisc)
W69-07837

SOME ASPECTS OF THE BACTERIOLOGY OF THE RUMEN,
Agricultural Research Center, Beltsville, Md. Animal Husbandry Research Div.
Marvin P. Bryant.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 366-393, 1964. 1 fig, 2 tab, 116 ref, disc.

Descriptors: *Bacteria, *Ruminants, Fermentation, Enzymes, Microorganisms, Protozoa, Metabolism, Habitats, Biochemistry, Anaerobic bacteria, Carbohydrates, Cultures, Cellulose, Amino acids, Sludge.
Identifiers: *Rumen, Alimentary tract, Nutrition, Physiology, Fatty acids, Glycerol, Methanobacterium ruminantium, Veillonella alcallescens, Ruminococcus albus, Bacteroides amylophilus, Butyrivibrio fibrisolvens, Ruminococcus flavefaciens, Selenomonas ruminantium, Streptococcus bovis, Bacteroides ruminocola, Bacteroides succinogenes, Peptostreptococcus elsdenii, Lachnospira multiparus, Succinovibrio dextrinosolvens, Eubacterium ruminantium, Borrelia, Anaerobic lactobacilli, Xylan, Starch, Lactate.

Differing from most bacteria in other natural habitats, rumen bacteria are significant in comparative biochemistry and nutrition. Primarily they ferment carbohydrates; also, they absorb volatile fatty acids as their energy source and hydrolyze protein to amino acids and peptides. Rumen fluid agar media with small amounts of certain carbohydrates were most successful for species culture and colony counts. They are mainly nonsporeforming anaerobes, isolated only from the rumen. Similar species occur in sediments of natural waters and sewage sludge. These differ in that methane is formed in sludge but not in the rumen. The 'rumen fluid' factor required by many cellulolytic bacteria seems to consist of a two-component requirement for volatile fatty acids stimulatory to cellulose digestion and protein synthesis under certain conditions. These acids, important in metabolism, may be required. Certain tetrapyrroles appear to be required mainly for synthesis of a cytochrome of the b type. The nitrogen requirements of many rumen bacteria are quite unusual compared to those of heterotrophic bacteria so far studied. Most species can be grown with ammonia as the main source of nitrogen. Some strains require amino acids; others not. Some species seem to utilize ammonia for growth in preference to organic nitrogen. (See also Vol. 2, No. 18, Field 5C, W69-07423) (Jones-Wisc)
W69-07839

PHYSIOLOGY OF THE RUMEN PROTOZOA,
Agricultural Research Center, Beltsville, Md. Animal Husbandry Research Div.
J. Gutierrez, and R. E. Davis.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, pp 394-404, 1964. 2 fig, 1 tab, 17 ref, disc.

Descriptors: *Ruminants, *Protozoa, *Bacteria, Cattle, Reproduction, Metabolism, Amino acids, Tracers, Proteins, Chromatography, Fermentation, Digestion, Lipids, Manometers, Streptococcus, Alfalfa.
Identifiers: *Rumen, *Physiology, Casein, Isotrichs, Holotrichs, Paramecium, Isotricha prostoma, Isotricha intestinalis, Dasytricha, Diplodinium ecaudatum, Entodinium simplex, Ophryoscolex caudatus, Starch, Epidinium ecaudatum, Diplococcus, Peptostreptococcus.

Some functions carried out by rumen protozoa are: producing fatty acids which are absorbed yielding energy to the host; aiding digestion of ingested substrates--starch, cellulose, and bacteria; serving as a source of protein for the host. Tracer experiments showed they are able to incorporate amino acids. As a source of protein, the protozoa furnished 20% of the host requirement. Protozoan protein was found to have a higher nutritive value than bacterial or yeast protein. Protein contributed to the host was calculated for several protozoa with the cellular nitrogen content experiments. Paper chromatography of acid-hydrolyzed suspensions has indicated a long list of amino acids contained in the protozoal protein, available to the host. The quantitative experiments on ammonia production from casein show that, for some rumen protozoa, ammonia can be an important product of nitrogen metabolism. They contribute to lipid metabolism of the rumen. All the common genera of protozoa are bacteria feeders. Protozoan requirements for growth were studied by in vitro culture work. Of the several media developed, ground rice starch, alfalfa, and Streptococcus bovis, made a successful medium. Attempts to grow the protozoa without living bacteria have been unsuccessful. (See also Vol. 2, No. 18, Field 5C, W69-07423) (Jones-Wisc)
W69-07840

MICROBIAL TRANSFORMATIONS OF SOME ORGANIC SULFUR COMPOUNDS,
Rutgers - The State Univ., New Brunswick, N. J. Dept. of Agricultural Microbiology.
Robert L. Starkey.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 405-429, 1964. 5 fig, 2 tab, 70 ref, disc.

Descriptors: *Sulfur, *Microorganisms, *Organic compounds, Detergents, Plants, Animals, Industrial raw materials, Proteins, Amino acids, Bacteria, Yeasts, Enzymes, Spores, Soils, Actinomycetes, Fungi, Ammonia, Nitrogen, Decomposing organic matter, E coli.
Identifiers: Alcaligenes metalcaligenes, Alcaligenes faecalis, Aspergillus niger, Penicillium, Claviceps

purpurea, Proteun vulgaris, Streptococcus lactis aerogenes, Proprionibacterium pentosaceum, Clostridium sporogenes, Clostridium tetanomorphum, Clostridium perfringens, Achromobacter cystinovorum, Pseudomonas aeruginosa, Fungi imperfecti, Schizophyllum commune, Scopulariopsis brevicaulis, Microsporeum gypseum, Shigella flexneri, Dissimilation, Interconversion.

Organic sulfur compounds show marked differences in susceptibility to microbial attack. Sulfatases of bacteria, fungi, and animal and plant tissue bring about the cleavage which results in production of sulfate by hydrolysis. Dissimilation of taurine and cysteic acid by fungi, bacteria, and actinomycetes resulted first in release of nitrogen as ammonia and sulfur as sulfite, then oxidized to sulfate. Dissimilation of cyst (e)ine produces sulfide, also elemental sulfur and sulfate. In decomposition, although sulfur in the cysteine is in a reduced state, the inorganic sulfur product need not be a highly reduced compound. Only one initial breakdown product from methionine consistently reported is methyl thiol. Cultures grown in a simple mineral salts medium containing methionine as the only organic substance were all similar, Gram-negative, non-sporulating bacteria. The only products formed were methyl thiol and dimethyl disulfide. Aspergillus sp gave results similar to those of the bacteria, differing in that it did not grow in a medium with methionine the only organic material. Interconversion of methionine and cysteine has been established. Although the microorganisms may be able to fulfill their requirements for each amino acid from the other, the dissimulation reactions proceed without any change to the other amino acid. (See also Vol. 2, No. 18, Field 5C, W69-07423).
W69-07841

BIODIALYSTAT: NEW SAMPLER FOR DISSOLVED ORGANIC MATTER,
Washington Univ., St. Louis, Mo. Dept. of Botany.
Bruce C. Parker.
Limnology and Oceanography, Vol 13, No 4, pp 722-723, Oct 1967. 1 fig.

Descriptors: *Organic matter, *Sampling, Analytical techniques, Aquatic environments, Dialysis, Water chemistry, Water pollution sources.
Identifiers: *Dissolved organic matter, *Biodialystat, Cyanocobalamine, Millipore filters.

The biodialystat is a device for collection of cell-free water for its content analysis of dissolved organic matter. The sampler is essentially a chamber which is placed in situ and which functions by permitting dialysis of ambient natural water against sterilized distilled water contained in the chamber. Equilibrium time must be standardized for each compound of interest. Cobalamine, for which author has used the biodialystat, reaches maximum concentration after 24-36 hours in lake water at 18-20 degrees C. Tested with millipore membrane (pore diameter 0.2 micron) in sewage sludge, phytoplankton cultures, and lake water, device remained impervious to microorganisms for at least five days. Author lists following advantages for sampler: eliminates local chemical differences in aquatic environments; eliminates need for protection of samples against biological changes between collection and analysis; eliminates errors due to variations in method for removal of seston; produces more reliable estimates of dissolved substances than do filtration methods. A bill of materials and a photograph of the device is included in the report. (Eichhorn-Wisc)
W69-07865

CHLORINATED HYDROCARBON PESTICIDES IN CALIFORNIA BAYS AND ESTUARIES,
California State Dept. of Fish and Game, Menlo Park. Marine Resources Operations.
For primary bibliographic entry see Field 05B.
W69-07920

THE INFLUENCE OF SALTS APPLIED TO HIGHWAYS ON THE LEVELS OF SODIUM AND CHLORIDE IONS PRESENT IN WATER AND SOIL SAMPLES,
Maine Univ., Orono. Dept. of Plant and Soil Sciences.
Frederick E. Hutchinson.
Maine Univ Project Completion Report, June, 1969. 18 p, 9 tab, 2 fig, 6 ref. OWRR Project A-007-ME.

Descriptors: Pollutant identification, *Saline soils, Soil-water relationships, Chlorides, Impaired water quality.

This research project was conducted to determine the effect of salt application to de-ice highways on the sodium and chloride levels in (1) streams and rivers, (2) private water supplies contiguous to highways and (3) soils bordering highways. Analyses of seven rivers in Maine from six samplings over a two-year period indicate that sodium and chloride concentrations are not affected by highway salting; since the level of both ions remained consistent throughout the period. Although the concentrations of both ions tended to increase from the headwaters to the mouth of the rivers, the average concentrations for 27 sites were 3.4 and 1.5 ppm for sodium and chloride, respectively. Semiannual analyses of 100 randomly selected wells along Maine highways indicate that levels of sodium and chloride are much higher than normal, averaging 69 and 162 ppm, respectively. Twenty-five percent of the wells were unfit for potable supplies because they contained in excess of 250 ppm of chloride. Sodium and chloride levels in soils contiguous to highways bear a direct relationship to the length of time over which highways have been salted. In areas where salt has been applied for 20 years the sodium levels have risen over a distance of 60 feet from the edge of the highway and to a depth of 18 inches. Sodium saturation of the soil approaches 15% at some sites, and chloride levels in the soilwater system ranged from 10 to 2525 ppm, thereby producing the equivalent of an 'alkali' condition.
W69-08120

5B. Sources of Pollution

REDUCTION OF RIVER HEAT POLLUTION BY TURBULENCE STIMULATION,
Sacramento State Coll., Calif. Dept. of Civil Engineering; and Connecticut Univ., Storrs. Dept of Civil Engineering.
Alan L. Prasuhn, and Victor E. Scottron.
Conn Univ School Eng Rep No 69-22, May 1969. 17 p, 6 fig, 23 ref. OWRR Proj No A-011-CONN.

Descriptors: *Thermal pollution, *Water pollution control, *Turbulence, *Mixing, Dispersion, Diffusion, Water temperature, Surface waters, Streamflow, Mathematical models.
Identifiers: Turbulence stimulation.

A wind tunnel study was made of a two-dimensional, heat stratified flow. A mathematical model was developed and compared with measured temperature profiles for flow over both smooth and rough boundaries. Increased turbulence greatly accelerated the mixing rates. The possibility is suggested that artificially induced turbulence might enhance mixing and stream temperature control. (Knapp-USGS)
W69-07702

CHEMICAL EQUILIBRIA AND ZONING OF SUBSURFACE WATER FROM JACHYMOV ORE DEPOSIT, CZECHOSLOVAKIA,
Geological Survey of Czechoslovakia, Prague.
For primary bibliographic entry see Field 05G.
W69-07703

OCCURRENCE AND SIGNIFICANCE OF PESTICIDE RESIDUES IN WATER,
Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab.
For primary bibliographic entry see Field 05G.
W69-07704

A SURVEY OF HEAT SINK CAPACITY OF MAJOR STREAMS WITHIN THE U. S.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
K. R. Wise, and B. M. Cole.
Battelle Mem Inst Pacific Northwest Lab Rep No 951, Jan 1969. 61 p, 2 fig, 2 tab, 8 ref, 2 append.

Descriptors: *Cooling water, *Thermal powerplants, *Streamflow, Water temperature, Surveys, Water quality control, Water quality act, Regulation, Water pollution control, United States.
Identifiers: Streamflow-temperature surveys, Water quality standards.

Data are presented indicative of the limitations of the cooling water supply in the nation. As an index of cooling potential for each major stream, heat input for a 1 deg F temperature rise, with the minimum monthly average flow recorded in a 10 yr period, is used. Based on this characteristic of the streams in the U.S. locations are identified on a regional basis, where alternative solutions to once-through cooling can be anticipated first. Water quality standards will also affect cooling water availability and an attempt is made to identify the potential impact of these standards. (Knapp-USGS)
W69-07720

A TEST SIMULATION OF POTENTIAL EFFECTS OF THERMAL POWER PLANTS ON STREAMS IN THE UPPER MISSISSIPPI RIVER BASIN,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
D. E. Peterson, and R. T. Jaske.
Battelle Mem Inst Pacific Northwest Lab Rep No 999, Dec 1968. 75 p, 23 fig, 3 tab, 32 ref, append. Contract No AT (45-1)-1830 AEC.

Descriptors: *Thermal pollution, *Thermal powerplants, *Mississippi River, *Mathematical models, *Systems analysis, Simulation analysis, Digital computers, Computer programs, Model studies, Mississippi River Basin.
Identifiers: Heat discharge model.

The 1964 thermal regimens of the Upper Mississippi River and 8 major tributary streams were simulated with the COL HEAT digital model. The potential impact of 1980 and year 2000 power requirements were simulated under the assumption of flow-through cooling of steam generating plants. The results indicate that by the year 2000 few, if any, plant sites will remain along the Mississippi River where flow-through cooling can be exclusively utilized for 1,000 MW units. (Knapp-USGS)
W69-07738

USE OF ANALOG COMPUTERS FOR SIMULATING THE MOVEMENT OF ISOTOPES IN ECOLOGICAL SYSTEMS,
Vanderbilt Univ., Nashville, Tenn. Graduate School.
R. B. Neel, and J. S. Olson.
Available from Clearinghouse as ORNL 3172 at $3.00 in paper copy and $0.65 in microfiche. W-7405-eng-26. ORNL-3172. US AEC, Oak Ridge Nat Lab, Oak Ridge, Tenn. 120 p. 24 fig, 3 tab, 21 ref.

Descriptors: *Simulation analysis, *Analog models, *Analog computers, *Ecosystems, *Carbon cycle, Carbon radioisotopes, Computer models, Radioecology.
Identifiers: *Analog computer simulation, Compartment models, Environmental radioactivity, Analog computer techniques.

Analog computers may be used to simulate movements of stable carbon and carbon-14 between compartments in ecosystem models. Simulation is achieved through solution of appropriate systems

of linear differential equations. When an analog model representing a four-compartment terrestrial ecosystem is used to describe the build-up and movement of carbon in the system, a series of linear lags in the approach of each compartment toward a steady state is observed. Similar results are obtained for carbon-14. However, analog techniques need not be restricted to simple ecosystem simulation. The same methods and combinations of analog computer components can be used for either simple or complex ecosystems. By considering more detailed compartment models and describing ecosystems with either linear (including variable-coefficient) or non-linear systems of differential equations, very complex ecosystems can be examined in detail. (Huff-Wisc)
W69-07819

TRACER STUDY OF THE PHOSPHORUS CYCLE IN SEA WATER,
Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography.
W. D. Watt, and F. R. Hayes.
Limnol Oceanogr, Vol 8, pp 276-285, 1963. 8 fig, 3 tab, 18 ref, disc.

Descriptors: *Cycling nutrients, *Phosphorus compounds, *Sea water, *Tracers, Bacteria, Chromatography, Cyanophyta, Diatoms, Decomposing organic matter, Ecosystems, Enzymes, Equilibrium, Eutrophication, Lakes, Phosphorus radioisotopes, Plankton, Water chemistry, Water pollution effects, Water pollution sources, Zooplankton.
Identifiers: *Phosphorus cycle, Comparative studies, Daphnia magna, Dynamic equilibria, Dissolved inorganic phosphorus, Fucus vesiculosus, Gammarus, Halifax, Nova Scotia, Millipore filtration, Nostoc, Paper chromatography, Particulate phosphorus, Phosphatases, Skeltonema, Turnover times.

The biological exchange of phosphorus between dissolved inorganic phosphorus (DIP), particulate phosphorus (PP) and dissolved organic phosphorus (DOP) fractions was studied by adding DIP-32 to sea water and following the amounts of P-32 in each of the three fractions with lime, steady-state conditions were assured. A rapid decline in DIP-32, a rapid increase in PP-32 and a relatively slow increase in DOP-32 were observed. The main exchange processes were concluded to be DIP with PP and PP with DOP. Because addition of DOP-32 to sea water resulted in more rapid accumulation of PP-32 than DIP-32, direct conversion of DOP to DIP was believed not to occur. Exchange rates (micrograms-atoms P/liter/day) measured in coastal water from near Halifax, N S, Canada, were 0.23 between DIP and PP and 1.2 between PP and DOP. Amounts of P in the DIP, PP and DOP fractions for this site were 0.35, 2.98, and 0.60 micrograms-atoms P/liter, respectively. The DOP-32 fractions were resolved by paper chromatography into six components. (Armstrong-Wisc)
W69-07822

EFFECT OF HANFORD REACTOR SHUTDOWN ON COLUMBIA RIVER BIOTA,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05C.
W69-07853

SOIL DEGRADATION OF DIAZINON, A PHOSPHOROTHIOATE INSECTICIDE,
Wisconsin Univ., Madison. Dept. of Soils.
J. G. Konrad, D. E. Armstrong, and G. Chesters.
Agronomy J, Vol 59, pp 591-594, Nov-Dec 1967. 3 fig, 3 tab, 10 ref.

Descriptors: *Degradation (Decomposition), *Insecticides, *Diazinon, *Phosphorothioate pesticides, *Soil chemistry, Adsorption, Hydrolysis, Water pollution sources, Soil contamination, Pesticide residues, Organic matter, Hydrogen ion concentration, Wisconsin, Toxicity.
Identifiers: 2-isopropyl-4 methyl-6 hydroxypyrimidine, Diethyl thiophosphoric acid, Poygan sicl soil, Kewaunee c soil, Ella ls soil.

Degradation of the insecticide diazinon was followed in acid soil-free systems and in soil systems. The mechanism of diazinon degradation in soils is a partial chemical hydrolysis with formation of 2-isopropyl-4-methyl-6-hydroxypyrimidine and diethyl thiophosphoric acid; hydrolysis in soils is adsorption catalyzed rather than acid catalyzed. Degradation rates were 11, 7, and 6% per day for three Wisconsin soils: Poygan sicl, Kewaunee c, and Ella ls, respectively; these rates were related to organic matter content and pH of the soil. (Konrad-Wisc)
W69-07867

COMPLIANCE WITH ARTICLE SUSPENDED WHERE REQUIRED EQUIPMENT UNOBTAINABLE; ALLOWANCE FOR PLANNING AND INSTITUTING CHANGES.
For primary bibliographic entry see Field 06E.
W69-07879

CHLORINATED HYDROCARBON PESTICIDES IN CALIFORNIA BAYS AND ESTUARIES,
California State Dept. of Fish and Game, Menlo Park. Marine Resources Operations.
John C. Modin.
Pesticides Monit J, Vol 3, No 1, pp 1-7, June 1969. 7 p, 1 fig, 6 tab, 7 ref.

Descriptors: *Pesticide residues, *Estuaries, *California, *Fish, Pollutants, DDT, Chlorinated hydrocarbon pesticides, Pesticide kinetics, Water pollution sources, Monitoring, Data collections.
Identifiers: DDD, DDE.

As part of a nationwide program to monitor organochlorine pesticide residues in estuaries, the U. S. Bureau of Commercial Fisheries in January 1966 contracted to the California Department of Fish and Game the responsibility to monitor selected estuaries in California for pesticides. Analyses of oysters, mussles, and clams sampled at points of interest within each estuary revealed DDT, DDD, DDE, dieldrin, and endrin in concentrations from 10 to 3,600 ppb. Calculations are based on the laboratory wet weight of homogenized tissue. In studies of offshore exposure, high levels of DDT, DDD, and DDE were found in a king crab (2,739 ppb) and in ova from a king salmon (668 ppb). Pesticides were also measured in the ova of prawn, flounder, halibut, and sole; of these, halibut ova were the most highly contaminated, with DDE, DDD, and DDT measuring 591 ppb. (Knapp-USGS)
W69-07920

PESTICIDE RESIDUES IN SEDIMENTS OF THE LOWER MISSISSIPPI RIVER AND ITS TRIBUTARIES,
National Communicable Disease, Atlanta, Ga.; Food and Drug Administration, Washington, D. C.; Agricultural Research Service, Oxford, Miss. Sedimentation Lab.; and Agricultural Research Service, Gulfport, Miss. Plant Pest Control Div.
W. F. Barthel, J. C. Hawthorne, J. H. Ford, G. C. Bolton, and L. L. McDowell.
Pesticides Monit J, Vol 3, No 1, pp 8-66, June 1969. 58 p, 5 fig, 31 maps, 9 tab, 2 ref.

Descriptors: *Pesticide residues, *Mississippi River, *Sediments, Silts, Sands, Clays, Pollutants, DDT, Dieldrin, Aldrin, Endrin, Heptachlor, Chlorinated hydrocarbon pesticides, Pesticide kinetics, Water pollution sources, Monitoring, Data collections.
Identifiers: Lower Mississippi River Basin.

Studies of the chlorinated hydrocarbon content of sediments and water from the lower Mississippi River and its tributaries were conducted in 1964, 1966, and 1967 to determine the extent and possible sources of agricultural pesticides in the streams of the Delta. The Mississippi River bed was sampled at 11 sites located between Tiptonville, Tenn., and New Orleans, La. Tributaries of the Mississippi in the Delta were sampled in Tennessee, Mississippi, Louisiana, and Arkansas. Pesticides residues were detected from both agricultural and nonagricultural sources: however, no evidence was found of a general buildup of chlorinated hydrocarbons in the sediments of these streams from farm use. Diedrin, aldrin, endrin, endrin keto, isodrin, chlordane, heptachlor, hexachloronorbornadiene, and heptachloronorbornene were found in sediment and water samples collected from Cypress Creek and Wolf River at Memphis, Tenn., near a primary manufacturer of endrin and heptachlor. Lower concentrations of several of these compounds were detected in sediments collected from tributary streams in Mississippi near formulating plants that prepare the technical pesticides for agricultural use. DDT analogs and metabolites were found in some of the tributary streams where no known formulators are located. (Knapp-USGS)
W69-07921

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE SAN ANTONIO RIVER BASIN, TEXAS,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02K.
W69-07927

HYDROLOGIC DATA: 1967, VOLUME 5: SOUTHERN CALIFORNIA,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 02E.
W69-07933

NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS, WATER YEAR 1969.
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 05G.
W69-07941

ANIMAL WASTES--A NATIONAL PROBLEM,
Cornell Univ., Ithaca, N. Y. Dept. of Agriculture; and Cornell Univ., Ithaca, N. Y. Dept. of Civil Engineering.
Raymond C. Loehr.
ASCE Proc, J Sanit Eng Div, Vol 95, No SA2, Pap 6493, pp 189-221, Apr 1969. 33 p, 4 fig, 9 tab, 86 ref. Contract No 14-12-88 FWPCA.

Descriptors: *Water pollution sources, *Water pollution control, *Farm wastes, *Confinement pens, *Reviews, Bibliographies, Waste treatment, Sewage treatment, Farm lagoons.
Identifiers: Animal waste problems.

A state of the art summary is given of the control and management of animal wastes. Items considered include the magnitude of the problem, pollution that has been caused by animal wastes, feasible treatment processes, major problem areas, and areas for future activity. The problems currently associated with the handling, treatment, and disposal of animal wastes will be magnified in the future. Ultimate disposal techniques for untreated animal solids and liquids as well as the residues from waste treatment processes should be integrated with feasible handling and treatment processes to develop suitable waste control and abatement systems. Large-scale animal production facilities should be considered as individual industries responsible for pollution abatement. (Knapp-USGS)
W69-08010

RURAL RUNOFF AS A FACTOR IN STREAM POLLUTION,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
R. B. Weidner, A. G. Christianson, and S. R. Weibel.

J Water Pollut Contr Federation, Vol 41, No 3, Part 1, pp 377-384, Mar 1969. 8 p, 6 fig, 10 tab, 3 ref.

Descriptors: *Water pollution sources, *Runoff, *Farms, *Farm wastes, Bacteria, Biochemical oxygen demand, *Erosion, Phosphates, Nitrogen compounds, Sediments.
Identifiers: Rural runoff.

Six cropped and mixed agricultural watersheds under experimental prevailing and improved crop land management at Coshocton, Ohio, and an apple orchard over meadow at Ripley, Ohio, were instrumented to sample and gage rainfall and storm runoff from the fields. Under prevailing practices monthly volume of runoff from fields was higher than that under improved practices such as contour plowing and strip cropping. More runoff developed from a field in corn than from one in wheat, and the least runoff developed from fields in meadow. Good correlations between rural runoff silt losses and total solids, and between total solids and BOD, COD, total hydrolyzable phosphate, and total nitrogen were found. Microbial tests showed that the bacterial sources were predominantly nonhuman, but total coliforms exceeded 1,000/100 ml in 90% of the samples in runoff from 2 of the rural watersheds. (Knapp-USGS)
W69-08013

OIL SPILLAGE PREVENTION, CONTROL, AND RESTORATION-STATE OF THE ART AND RESEARCH NEEDS,
Battelle Memorial Inst., Richland, Wash.; and Hydronautics, Inc., Laurel, Md.
For primary bibliographic entry see Field 05G.
W69-08014

PORE GAS COMPOSITION UNDER SEWAGE SPREADING,
Robert A. Taft Santiary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
R. E. Thomas, W. A. Schwartz, and T. W. Bendixen.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 419-423, May-June 1968. 5 p, 4 fig, 16 ref.

Descriptors: *Sewage disposal, *Water spreading, *Filtration, *Aerobic treatment, Water pollution effects, Septic tanks, Lysimeters, Oxygen, Carbon dioxide, Microorganisms.
Identifiers: Pore gas, Pore clogging.

Septic tank effluent was applied to sand in laboratory lysimeters. Dosing frequencies of 2/day and 6/day were used to observe relationships between changes in the composition of the pore gas and the clogging of the sand. The rate of clogging in the 2/day unit was less than that in the 6/day unit. This reduced rate of clogging was related to pore-gas and moisture content changes which occurred in the sewage dosing and drainage cycles. The longer cycle of the 2/day frequency provided more oxygen over a greater percentage of the total elapsed time. In the 6/day lysimeter the rapid soil clogging, which is characteristic for anaerobic conditions, started while the oxygen concentration in the pore gas was greater than 13 percent. Water-filled pores or water films, occurring as the result of an increase in the moisture content, may have provided anaerobic sites in the presence of the high pore-gas oxygen. Carbon dioxide inhibition of microbial growth did not cause the rapid phase of clogging. Moisture or oxygen determinations may be suitable guides for prevention of the rapid phase of soil clogging. (Knapp-USGS)
W69-08027

CHLORINATED INSECTICIDES IN RUNOFF WATER AS AFFECTED BY CROP ROTATION,
Agricultural Research Service, Orono, Maine. Dept. of Plant and Soil Science; and Maine Univ., Orono. Water Resources Center.
E. Epstein, and W. J. Grant.
Soil Sci Soc Amer Proc, Vol 32, No 3, pp 423-426, May-June 1968. 4 p, 6 tab, 20 ref.

Descriptors: *Pesticides, *Runoff, *Rotations, Water pollution sources, Path of pollutants, DDT, Endrin, Gas chromatography.
Identifiers: Crop rotation effects.

The concentration and amounts of 3 chlorinated insecticides were lower in runoff from a rotation system of potato, oats, and sod, than under continuous potato cropping. Runoff samples from natural runoff plots were collected following each storm, and the amounts of DDT, endrin, and endosulfan were analyzed with a gas chromatograph. The amounts of pesticides in runoff were small compared to the amount applied. The concentrations of the insecticides in the runoff (soil-water suspension) were generally greater than those found in the settled soil (sludge). (Knapp-USGS)
W69-08028

WASTES IN RELATION TO AGRICULTURE AND FORESTRY,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 05C.
W69-08029

5C. Effects of Pollution

OCCURRENCE AND SIGNIFICANCE OF PESTICIDE RESIDUES IN WATER,
Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab.
For primary bibliographic entry see Field 05G.
W69-07704

THE EFFECT OF PUMPED-STORAGE RESERVOIR OPERATION ON BIOLOGICAL PRODUCTIVITY AND WATER QUALITY,
Virginia Commonwealth Univ., Richmond; and Virginia Polytechnic Inst., Blacksburg.
G. M. Simmons, Jr., and S. E. Neff.
Virginia Polytech Inst Water Resources Res Center Bull No 21, Mar 1969. 47 p, 7 fig, 22 tab, 18 ref. OWRR Project No A-012-VA.

Descriptors: *Eutrophication, *Reservoirs, *Pumped storage, Water quality, Nutrients, Sewage, Water pollution, Reaeration, Aeration, Mixing, Stratification, Thermal stratification, Pumping.
Identifiers: Pumped-storage reservoirs.

Smith Mountain Reservoir, Virginia, a pumped-storage hydrogeneration system, which reached its operating capacity in February 1965, has developed some of the limnological attributes of a mesotrophic lake. The impoundment is rapidly developing the characteristics of older, eutrophic, main-stream reservoirs, despite the recycling of large quantities of water during pump-storage operation. The body of water behaves as a warm monomictic lake. A relatively shallow (5-8m) epilimnion forms during stratification. The metalimnion is nearer the surface in the proximity of the dam during pump-back. The anticipated beneficial effects of the recycling process appear to be limited. Seiche action begun by recycling seems to increase carbon assimilation rates in the vicinity of the dam by eddy diffusion of nutrients across the metalimnion. Seiche activity is restricted by basin morphometry, but its influence can be detected 6.5 mi above the dam. In the lower parts of the impoundment, anaerobic conditions in the hypolimnion were not reached although dissolved oxygen concentrations were severely reduced. In the shallower upper reaches of the impoundment, anaerobic conditions developed by late spring. The highest concentrations of dissolved oxygen were encountered in spring and early summer in the epilimnion. Total coliform counts made at various times in the reservoir also emphasize the quantities of effluents that enrich the upper portions of the impoundment. These counts also point out the self-evident fact that water quality improvement in pump-storage reservoirs depends upon the quality of the water which is recycled. (Knapp-USGS)
W69-07711

A TEST SIMULATION OF POTENTIAL EFFECTS OF THERMAL POWER PLANTS ON STREAMS IN THE UPPER MISSISSIPPI RIVER BASIN,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W69-07738

A RECONNAISSANCE STUDY OF THE CHESAPEAKE BAY,
Regional Planning Council, Baltimore, Md.
For primary bibliographic entry see Field 05G.
W69-07742

PROMISING ANTI-POLLUTANT: CHELATING AGENT NTA PROTECTS FISH FROM COPPER AND ZINC,
Fisheries Research Board of Canada, St Andrews (New Brunswick), Biological Station.
John B. Sprague.
Nature, Vol 220, No 5174, pp 1345-1346, Dec 1968. 1 tab, 10 ref.

Descriptors: *Chelation, *Copper, *Pollution abatement, *Zinc, Bioassay, Brook trout, Lethal limit, Metals, Toxicity.
Identifiers: *Anti-pollution agent, Nitrilotriacetic acid, NTA, Pimephales, Salvelinus.

Copper and zinc are widespread pollutants both in industrial areas (waste spillage) and wilderness areas (mining operations). A chelating agent, nitrilotriacetic acid (NTA) appears to be a promising short-term anti-pollutant. Bioassays involving copper and zinc, alone, in mixtures, and in combination with NTA were carried out on brook trout over periods of ten days. Ten fish were used in each 34-liter bioassay tank (no statement of replications is given), the fish being maintained under conditions otherwise considered optimum for the species. Individual times of death were recorded and lethal thresholds (in milligrams/liter) were obtained for copper (0.05) and zinc (0.75). Thresholds were given a 'toxic unit value' of 1.0. Addition of NTA caused a decrease in toxicity (longer survival of fish) at most concentrations of metals (up to 330 toxic units). NTA chelates at ratios of 1 molecule NTA:1 ion metal and selectively chelates copper before acting upon zinc. NTA is apparently as effective as EDTA and costs less. Tabular material gives selected results of mixed copper-zinc toxicity trials, with and without NTA. (Voightlander-Wisc)
W69-07817

THE GALLOPING GHOST OF EUTROPHY,
New Hampshire Water Supply and Pollution Control Commission.
Terrence P. Frost.
Appalachia, Vol XXXVII, No 1, pp 25-36, June 1968. 1 fig, 4 plates.

Descriptors: *Eutrophication, *Lakes, Glaciation, Urbanization, Domestic wastes, Nutrients, Phosphorus, Algae, Algicides, Harvesting of algae, Environment, Cyanophyta.
Identifiers: *Aesthetic deterioration, *Advanced waste treatment, *Nutrient removal, Agricultural drainage, Appalachian Mountain Club huts, Tegernsee, Germany, Expanding technology, Overpopulation.

The increased influence of man on the environment has caused a change in the definition of eutrophication from a natural aging process of lakes due to topography, degree of fertility, sediment loads from mineral and organic solids, subsurface geology, and weathering, to an accelerated aging due to man's influence. Increasing urbanization along with our changing life style, is suggested as the cause for 'galloping eutrophy.' The effect is the proliferation of algal species, harmless and diversified in small numbers; noxious and confined to profusion of a few hardy blue-green species in overpopulation. The result is aesthetic deterioration, fish kills, septic odors, discoloration of objects

in water, organic debris buildups on bottoms, scums and mats. Suggested methods of control include chemical treatment with algicides or harvesting organisms, but these eliminate symptoms without reaching the causes. Real need is nutrient removal from sewage effluent by a variety of techniques, coagulation (lime or alum), reverse osmosis, ion exchange, electrodialysis, distillation, hydrophonics, and irrigation. Mention is also made of methods and improvements in waste disposal at Appalachian Mountain Club huts and the Tegernsee Recreation area in Germany. Author's conclusion: The heart of the problem lies in unharnessed technology and people pollution. (Ketelle-Wisc)
W69-07818

DIGITAL COMPUTER SIMULATION OF AN ECOLOGICAL SYSTEM, BASED ON A MODIFIED MASS ACTION LAW,
Pennsylvania Univ., Philadelphia. Johnson Research Foundation.
David Garfinkel, and Richard Sack.
Ecology, Vol 45, No 3, pp 502-507, Summer 1964. 4 fig, 2 tab, 26 ref.

Descriptors: *Digital computers, *Ecosystems, *Simulation analysis, Computer models, Computer programs, Ecology, Systems analysis, Trophic level.
Identifiers: *Mass action law, Ecosystem computer simulation, Plant-herbivore-carnivore system, Ecosystem stability analysis, Theoretical ecology, Lotka-Volterra equations, UNIVAC I, UNIVAC II.

Utilizing digital computer, a simulation model was devised for a six-species ecosystem, starting with Lotka-Volterra's mass-action mechanism and introducing modifications as required by ecological reality. Their computer program permits description of the system in terms of species and their interactions, without requiring manipulation of differential equations. Behavior of the simulated ecosystem is in good agreement with reality, and some testable hypotheses emerge. Some properties of the system: Total biomass in the systems determines highest predatory level it will support; two species cannot simultaneously occupy same food-chain position; important stabilizing influences include sufficiently large predator populations, negative feedback controls on reproduction, and presence of immature predators which have food consumption different from adult or which otherwise affect food consumption of adult; and ecosystems may have time cycles of distinct length, resistant to perturbation. While complex mathematical models may not be ecologically valid, and ecologically valid models may not generate ecologically useful results, computer simulation of realistic ecosystems is feasible without requiring undue mathematical effort by user. (Eichhorn-Wisc)
W69-07823

SEAWEED EXTRACTS AS FERTILISERS,
Portsmouth Coll. of Tech. (England). School of Pharmacy.
G. Blunde, S. B. Challen, and D. L. Woods.
J Sci Food Agric, Vol 19, pp 289-293, June 1968, 1 fig. 8 tab, 26 ref.

Descriptors: *Fertilizers, *Cycling nutrients, Eutrophication, Algae, Plant growth substances, Plant growth, Carbohydrates.
Identifiers: *Seaweed extracts, Ascophyllum nodosum, Alginic acid, Fucus vesiculosus, Growth factors, Laminaria saccharina, Mannitol, Mustard growth test, Organic growth factors, Polysaccharides.

In the mustard-growth test, the growth-promoting effects of aqueous extracts of Laminaria saccharina, Fucus vesiculosus and Ascophyllum nodosum were largely due to the metal cations present, but the effects were modified by organic substances in the extracts. Amino acids and mannitol in seaweed extracts had little effect on plant growth, and compounds extracted with organic solvents were only partially responsible for the modification of the growth-promoting effect. The polysaccharide alginic acid and its salts seemed to be the main organic compounds responsible for reducing the effects of metals and may have competed with the plants by ion exchange for the metals in the extract. (Konrad-Wisc)
W69-07826

THE REACTIONS OF FISH TO WATER OF LOW OXYGEN CONCENTRATION,
University Coll. of Wales, Aberystwyth. Dept. of Zoology.
J. R. Erichsen Jones.
J. Exper Biology, Vol 29, pp 403-415, 1952. 8 fig, 22 ref.

Descriptors: *Behavior, *Dissolved oxygen, *Fish, Brown trout, Minnows, Sticklebacks, Oxygen demand.
Identifiers: *Depleted oxygen, *Dyspnoea, *Swimming reactions, Phoxinus, Salmo trutta, Gasterosteus aculeatus.

The behavior of three species of fish was observed in relation to experimentally induced conditions of low oxygen concentration, the majority of the observations being made on the stickleback. At oxygen concentrations of 2.0 to 3.0 milligrams/liter (mg/1), (temperature 13 C), fish moved easily into areas of low oxygen concentrations, but if remaining there, developed dyspnoea (increased amplitude and frequency of opercular movements) and a random pattern of active swimming. At concentrations below 2.0 mg/1, the response was more rapid, and a definite avoidance response was noted. At concentrations above 3.0 mg/1, results were more variable, with dyspnoea requiring a longer time to develop. At high concentrations, some fish apparently were able to adapt to low oxygen concentrations by increasing the amplitude and frequency of opercular movements. Experiments at higher and lower temperatures yielded the same results, with the response rate varying directly with temperature. The same patterns were noted for Phoxinus and brown trout. Author concludes that random, active swimming, induced by dyspnoea and under the influence of temperature, enables fish to escape areas of low oxygen concentration. (Voigtlander-Wisc)
W69-07830

LIMNOLOGICAL CONDITIONS AND GROWTH OF TROUT IN THREE LAKES NEAR ROTORUA,
Marine Dept., Rotorua (New Zealand).
G. R. Fish.
Proc N Z Ecol Sco, No 10, pp 1-7, 1963. 3 fig, 3 tab, 15 ref.

Descriptors: *Eutrophication, *Growth rates, *Primary productivity, *Rainbow trout, Distribution, Dissolved oxygen, Water temperature.
Identifiers: *Limnological conditions, *New Zealand, *Salmo gairdneri, Lake Okataina, Lake Ngapouri, Lake Okaro, von Bertalanffy curves.

Factors affecting water quality were correlated with growth and population density of trout in three New Zealand lakes. All three lakes stratify and are fed by seepage and surface runoff. Lake Okataina receives no nutrient load in terms of fertilizers and domestic animal sewage, while Lakes Ngapouri and Okaro receive runoff from highly developed agricultural (pasture) land. Secchi disk readings in January were 13.0, 4.0 and 3.6 meters for Okataina, Ngapouri and Okaro, respectively. Estimates of asymptotic length (centimeters) and growth rate (K) were 48.9, 0.09; 23.2, 0.09; 31.0, 0.15, for the respective lakes. Estimated population densities in terms of numbers and weight (transformed to killograms/hectare by abstractor) for the three lakes were: Okataina 13,900, 23.7; Ngapouri 1,500, 23.3; Okaro 720, 16.3. Although differences in growth of trout in the latter two lakes may be related to population density, and the absolute size of the three lakes may be important, it appears that eutrophication resulting from agricultural development has produced an inferior environment for trout in Lakes Ngapouri and Okaro. (Voigtlander-Wisc)
W69-07831

ALGAE AND MAN.
Syracuse Univ., N.Y. Dept. of Civil Engineering.

From Symp on Algae and Man, NATO Advanced Study Inst, Louisville, Ky, 1962. Daniel F. Jackson, (ed). Plenum Press, New York, 1964. 90 fig, 48 tab, 1000 ref.

Descriptors: *Eutrophication, *Algae, Bioassay, Biological communities, Cultures, Diatoms, Ecology, Nuisance algae, Phaeophyta, Photosynthesis, Phytoplankton, Primary productivity, Systematics, Water pollution effects, Water pollution sources, Water supply.
Identifiers: Benthic algae, Blooms, Closed systems, Cytology, Environmental conditions, Extracellular products, Gas exchange, Green plants, Mass culture, Medicine, Metabolic patterns, Microalgae, Micronutrients, Phycology, Space research, Toxic algae.

This compendium is based on a series of lectures presented at the NATO Advanced Study Institute, the first to be held in the United States, which met at the University of Louisville, Kentucky, July 22-August 11, 1962. The series bears on the role of algae in eutrophication of natural waters and on their possible utilization for closed life-support systems in the space age. The scope of the work is indicated by names of authors and topics of their contributions: G. W. Prescott, systematics; C van den Hoek, taxonomy; Tyge Christensen, gross classification; Margaret Roberts, cytology of Phaeophyta; G. E. Fogg, environmental conditions and algal metabolic patterns; Clyde Eyster, micronutrient requirements; A. G. Wurtz, problems of culture; F. E. Round, ecology of benthic algae; Ruth Patrick, diatom communities; James B. Lackey, ecology of planktonic algae; Jacob Verduin, principles of primary productivity; C. Mervin Palmer, algae in water supplies; Otto Skulberg, eutrophication and bioassay; George P. Fitzgerald, biotic relations in blooms; Paul R. Gorham, toxic algae; Marcel Lefevre, extracellular products; David and Morton Schwimmer, algae and medicine; Richard J. Benoit, mass culture for gas exchange; and F. Evens, future of phycology. WSelected individual contributions to the volume will be abstracted individually. (See also Vol 2, No 5, Field 5C, W69-01977). (Eichhorn-Wisc)
W69-07832

ALGAL PROBLEMS RELATED TO THE EUTROPHICATION OF EUROPEAN WATER SUPPLIES, AND A BIO-ASSAY METHOD TO ASSESS FERTILIZING INFLUENCES OF POLLUTION ON INLAND WATERS,
Norsk Institutt for Vannforskning, Blindern.
Olav M. Skulberg.
Algae and Man, Jackson, Daniel F, ed, Plenum Press, N Y, pp 262-299, 1964. 16 fig, 9 tab, 76 ref.

Descriptors: *Algae, *Bioassay, *Eutrophication, *Fertilization, *Inland waterways, *Water pollution effects, *Water supply, Bioindicators, Calcium, Chlorides, Conductivity, Cultures, Hydrogen ion concentration, Iron, Lakes, Magnesium, Nutrients, Nuisance algae, Oligotrophy, Odor, Phytoplankton, Sulfates, Sedimentation, Sediments, Taste, Water chemistry, Water quality.
Identifiers: *Europe, Algal growth, Ankistrodesmus, Bacillariophyceae, Chlorophyceae, Chrysophyceae, Carteria, Comparative studies, Crucigenia rectangularis, Diceras Chodati, Dinophyceae, Filter blocking, Heteretrophs, Italy, Lake Borrevannet Norway, Lake Lugano Italy, Lake Maridalsvannet Norway, Lake Zurich, Switzerland, Nitelv River Norway, Norway, Oscillatoria rubescens, Oslo Norway, Permanganate values, Schizophyceae, Selenastrum capricornutum, Tabellaria flocculosa.

The author lists among the problems caused by excessive algal growth, filter-blocking, impartation of taste and odor to water supplies, discoloration of water, provision of nutrients for undesirable heterotrophs in pipes, and formation of sediments in lakes. To illustrate differences in trophic status among lakes, he compares two lakes in Norway: Lake Maridalsvannet (3.9 square kilometers; maximum depth, 45 meters) which provides Oslo with drinking water, is oligotrophic, and shows little annual variation in its low concentrations of dissolved nutrients. Lake Borrevannet (1.8 square km; max depth, 16 meters) is eutrophic and shows important annual changes with respect to chemistry and water quality. Author states that Lake Lugano, northern Italy, has eutrophied due to pollution enrichment, citing classic example of Lake Zurich as evidence that lacustrine trophic changes are best recorded in the sediments. Utilizing Selenastrum (or Ankistrodesmus) capricornutum, an organism requiring only a few days to attain peak growth, author devised a bioassay to assess effects and concentrations of nutrients in natural waters. Such an approach would appear to have its greatest value in comparative limnological studies. (See also W69-07832). (Eichhorn-Wisc)
W69-07833

THE BACTERIOLOGY OF INTERFACES,
Johns Hopkins Univ., Baltimore, Md. Dept. of Sanitary Engineering and Water Resources.
Charles E. Renn.
Proc. Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 193-201, 1964. Disc.

Descriptors: *Bacteria, *Interfaces, Biochemical oxygen demand, Boulders, Boundaries (Surfaces), Diatoms, Emulsions, Films, Foaming, Fouling, Gases, Oxygen, Paints, Pipes, Plastics, Rocks, Ships, Soil microbiology, Suspensions, Walls, Waterproofing, Gages.
Identifiers: Rutgers Univ, Woods Hole Oceanographic Inst, La Jolla (Calif), Scripps Inst Oceanography, Silicones, Tanks, Zeolites, Atmosphere.

In marine studies in the laboratory thin bacterial films developed on containing walls, and changes in the ratio of surface to volume were related to the rate at which oxygen was used. On boats, bacterial films seemed not to hasten wetting of surfaces, but their hastening or retarding of attachment of larger fouling organisms was questioned. The interface, a microbiological environment, showed in thin, compressed film of rods and cocci gathered on slides floated on water surface. Fixed surfaces, wetted by flowing water, support films of bacteria and larger organisms. These mechanisms for purifying waste water act as stripping systems adsorbing organic matter and oxidizing it. Heavy sludges appeared in pure-water tanks containing low concentrations of organic materials. Bacterial slimes, ranging from viscous syrups to rubbery gels, cause clogging in dehumidifier sections of air systems. These slimes resemble the dense growth of Sphaerotilus and similar bacteria in some waste-bearing streams in winter. The irrigated surfaces of the stream bottom behave as initial interfaces, but heavy developing streamer growth becomes its own interface. Bubbles in activated sludge treatment serve as interfaces. Perhaps the affinity of surface-active organics and active bacteria of bubbles aids manipulation of activated sludge. (See also Vol. 2, No. 18, Field 5C, W69-07423). (Jones-Wisc)
W69-07834

RESEARCH IN AQUATIC MICROBIOLOGY: TRENDS AND NEEDS,
Rutgers - The State Univ., New Brunswick, N. J. Dept. of Environmental Sciences.
H. Heukelekian, and Norman C. Dondero.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero Norman, C (eds), John Wiley and Sons, Inc, New York, pp 441-452, 1964. 39 ref.

Descriptors: *Aquatic microbiology, *Research and development, *Microorganisms, *Water quality, *Chemical reactions, E coli, Salmonella, Sphaerotilus, Pseudomonas, Azotobacter, Bacteria, Protozoa, Fungi, Actinomycetes, Plankton, Periphyton, Benthos, Biochemistry, Physiological ecology, Nutrients, Tracers, Metabolism, Anaerobic conditions, Ecology, Lakes, Ponds, Cultures, Sampling, Nitrogen fixation, Pollutants, Methane bacteria, Bacteriophage, Soil microbiology.
Identifiers: Aerobacter aerogenes, Vibrio, Bacillus, Bdellovibrio bacteriovorus, Beijerinckia, Media, Special diversity, Industrial raw materials.

In relation to water problems, the potentially fruitful activities toward understanding scientific principles dealing with bacteria, protozoa, fungi, and actinomycetes, are discussed. Composition of bacterial plankton, bacterial periphyton, and benthic bacteria, with their specific biochemical roles, needs study. Adjustment at the species level of microbial populations to chemical or physical changes in environment and their reactions at cellular and molecular levels are significant. Important are: the physiology of the coliform group, apart from the intestinal tract; species composition in different nutrients; greater use of isotope tracer techniques applied to rumen metabolism, benthic decomposition, land anaerobic digestion; certain organic molecules as limiting growth factors; microorganisms surviving and reproducing at low nutrient levels. Long-term programs on ecological significance of bacterial distribution are desirable. An autochthonous flora of lakes and ponds, different in composition from that washed from the soil, may exist. Media and methods of culturing sample collections and preservation of samples require improvement. Studies of particular genera or species are beneficial in that studies of this type lead to more concentrated, intelligible results. Nitrogen-fixing bacteria in association with aquatic plants, the role of Bacillus species in pollution, more work on methane-forming bacteria, a small vibrio behaving like bacteriophage--all are challenging. (See also Vol 2, No 18, Field 05c, W69-07423). (Jones-Wis)
W69-07843

MODELING THE BEHAVIOR OF RADIONUCLIDES IN SOME NATURAL SYSTEMS,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
L. L. Eberhardt, and R. E. Nakatani.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symposium on Radioecology, Proc 2nd Natl Symp, Ann Arbor, Mich, pp 740-750, May 15-17, 1967. 1 tab, 36 ref, disc. CONF-670503.

Descriptors: *Radioecology, *Model studies, Ecology, Food chains, Ecosystems, Systems analysis.
Identifiers: *Radioactivity uptake, Ecosystems modeling, Uptake and retention models.

When the effects of connected compartments and auxiliary influences are ignored, simple uptake and retention models hold promise for use in appraising the substantial variability observed in the radionuclide content of individuals and populations. Although animals tend to function as 'integrators' over their food sources, relative variability in radionuclide content does not increase up the food chain as one might expect. One major cause of observed variances may often be variability in loss and excretion rates. The observed variability in body-burden from individual living in the same general environment may need appraisal in terms of at least three components: (1) that due to fluctuations in intake (stationary and non-stationary), (2) differences in metabolic rates associated with size, and (3) the usual melange of small individual differences which contribute to 'residual error' in a balanced analysis. (See also Vol 2, No 18, Field 05C, W69-07441). (Huff-Wis)
W69-07844

EFFECTS OF TEMPERATURE ON THE SORPTION OF RADIONUCLIDES BY A BLUE-GREEN ALGA,
Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
R. S. Harvey.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symposium on Radioecology, Proc 2nd Natl Symp, Ann Arbor, Mich, pp 266-269, May 15-17, 1967. 7 fig, 2 tab, 5 ref.

Descriptors: *Algae, *Radioisotopes, *Sorption, *Temperature, South Carolina, Cesium, Strontium radioisotopes, Zinc radioisotopes, Iron, Manganese, Benthic flora, Streams, Cultures, Cobalt radioisotopes.
Identifiers: Savannah River Laboratory, Plectonema boryanum, Reactor.

The effects of temperature differential (15 degrees Celsius) on sorption of cesium-137, zinc-65, iron-59, cobalt-57, and manganese-54, by the filamentous cyanophyte, Plectonema boryanum, are reported. The alga was collected from reactor effluent streams. Unialgal cultures were developed. Cultures were grown concurrently at four water temperatures and samples weighed and radio-assayed after exposures of increasing times. This species grew best between 30 C and 40 C. Growth was not affected by low concentrations of radionuclides in the medium. Radionuclide concentrations at the various water temperatures were compared. For a given water temperature, sorption levels differed for the radionuclides studied because of variances in specific activity and biological demand for various elements. The essential elements of manganese-54, xenon-65, cobalt-57, and iron-59, were sorbed to higher levels than were the nonessential elements, strontium-85 and cesium-137, perhaps due in part to their physical state; only cesium-137 and strontium-85 were present, mainly in ionic form. Since sorption levels for the various radionuclides were raised or lowered by factors less than 2.5 by the temperature differential, the conclusion was drawn that nonlethal variations in water temperature have no major influence on the sorption by P boryanum of the radionuclides tested. (See also Vol. 2, No. 18, Field 5C, W69-07441).
W69-07845

ACCUMULATION OF RADIUM-226 IN TWO AQUATIC ECOSYSTEMS,
Utah State Univ., Logan. Dept. of Wildlife Resources.
Susan S. Martin, William T. Helm, and William F. Sigler.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symposium on Radioecology, Proc 2nd Natl Symp, Ann Arbor, Mich, pp 307-318, May 15-17, 1967. 10 fig, 14 ref, disc. CONF-670503.

Descriptors: *Aquatic environments, *Ecosystems, *Radium radioisotopes, *Uranium radioisotopes, Rivers, Mills, Colorado, Wastes, Biological communities, Sediments, Biota, Fish, Utah, Algae, Insects, Invertebrates, Background radiation, Flocculation, Pollutants, Sampling.
Identifiers: Animas River, Durango, San Miguel River, Dolores River, Uravan, Cottus spp, Rhinichthys osculus, Suckers, Ictalurus punctatus, Trichoptera, Odonata, Ephemeroptera, Plecoptera, Diptera, Coleoptera, Hemiptera, Mollusca, Raffinate, Thorium, Tailings.

Radium-226, in uranium processing wastes, seriously affects stream biota. Its accumulation in biotic components was followed for three years. The Animas River, Colorado, after diversion of the most toxic of a mill's effluents, showed excellent recovery biologically. Water, sediment, algae, invertebrates, and fish, were sampled above and below mill sites. Comparison of background levels and radium accumulation showed differences in uptake by various fish species. A concentration factor (the ratio of the concentration of a particular

radionuclide in the organism to its concentration in the aqueous medium) showed the mean radium-226 content decreasing with downstream distance. During the last two years, radium content of sediments averaged only about three times background levels, earlier samples contained up to twenty times, while still earlier work indicated up to several hundred times the background levels of radium-226. The San Miguel-Dolores River system was in poor biological condition due primarily to chemical pollution from a uranium mill. Biota samples contained increasing amounts of radium-226 as distance below the mill increased, although radium-226 content of the water and sediments decreased with distance. Apparently organisms could not survive long enough in the upper pollution zone to accumulate the amounts of radium-226 which might otherwise be found. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07846

ECOLOGY OF TWO POPULATIONS OF AN AQUATIC ISOPOD (LIRCEUS FONTINALIS RAF.), WITH EMPHASIS ON IONIZING RADIATION EFFECTS,
Emory Univ., Atlanta, Ga. Dept. of Biology.
C. E. Styron.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 53-60. 2 fig, 2 tab, 32 ref, disc.

Descriptors: *Ecology, *Isopods, *Radiation effects, Environmental effects, River basins, Background radiation, Ecosystems, Granites, Temperature, Droughts, Biological communities, Age, Maple trees, Herbicides, Silts, Dragonflies, Salamanders, Crayfish, Insects, Larvae, Behavior, Life cycles, Georgia.
Identifiers: Lirceus fontinalis, DeKalb County (Ga), Mount Arabia (Ga), Lullwater Creek (Ga), Mutation rate, Beech-maple stands, Physiology, Taxonomy.

Results are reported of comparative study of isopods' biological reactions to various environmental stresses, including ionizing radiation, as well as extending and testing previous biometrical conclusions relative to environmental tolerances. In DeKalb County, Georgia, two populations of Lirceus fontinalis are isolated from each other in separate river drainages and are evolving in response to different environmental stresses. Background radiation counts from naturally occurring radionuclides in granite at Mount Arabia is several times above average for terrestrial ecosystems. Drought and high temperatures apparently are the main ecological factors limiting population on Mount Arabia. These factors are unimportant to the population in Lullwater Creek, where biotic factors have primary ecological significance for Lirceus. On Mount Arabia, tolerances to gamma radiation and drought stress increase significantly with age of Lirceus, which are 7.88 times more tolerant to ionizing radiation stress and 5.36 times more tolerant to drought stress than those of Lullwater Creek. Differences in reactions between Lirceus of Lullwater Creek and Mount Arabia to acute gamma radiation, temperature, and drought stress, may have developed during evolutionary period in response to diverse selection pressures. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07847

EFFECT OF SUBLETHAL GAMMA IRRADIATION ON THE IRON METABOLISM OF THE PINFISH, LAGODON RHOMBOIDES,
Bureau of Commercial Fisheries, Beaufort, N. C. Radiobiological Lab.
David W. Engel.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 152-156. 3 fig, 1 tab, 13 ref.

Descriptors: *Gamma rays, *Iron, *Metabolism, Blood, Radioactivity, Spectrometers, Size, Sea water, Fresh water, Mammals, Volume, Distribution.
Identifiers: *Pinfish, Kidney, Spleen, Liver, Beaufort Radiobiological Laboratory, Tench, Lagodon rhomboides, Detector.

The hematopoietic system of fish, in contrast to that of mammals, has not been investigated extensively. The effect of acute irradiation of iron metabolism of the pinfish, Lagodon rhomboides, was investigated by measuring specific activities of injected iron-59 (Fe-59) in the blood and tissues of irradiated and unirradiated fish. The radiation dose of 2000 rads markedly disrupted iron metabolism, and affected the distribution of Fe-59 in blood, liver, spleen, and kidney, at different times after irradiation. Decreased specific activity of the blood of irradiated fish for more than 22 days indicated depressed erythrocyte production; increased specific activity above the level of the controls on the 36th day indicated recovery of erythropoiesis. Radiation altered the size distribution of blood cells and the cell volumes, both effects indicating that larger and younger cells were being released into the circulation from 14-28 days after irradiation. Postirradiation changes in specific activities of kidney and spleen suggested that the kidney was the major erythropoietic organ and that the spleen had no more than a minor role in erythrocyte production. Changes in the specific activity of the liver suggested that it functioned only in iron storage and mobilization. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07848

INTERACTING EFFECTS OF GAMMA RADIATION AND SODIUM HALIDE CONCENTRATIONS ON RAINBOW TROUT,
Utah State Univ., Logan. Ecology Center.
John M. Neuhold, and R. K. Sharma.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 142-151. 9 fig, 3 tab, 15 ref, disc.

Descriptors: *Cesium, *Gamma rays, *Rainbow trout, *Sodium chloride, *Sodium compounds, Time, Oxygen, Habitat, Water, Arid climates, Nuclear explosions, Radioactivity, Temperature, Monitoring, Fluorometry, Chemical properties, Calcium, Magnesium, Mortality.
Identifiers: Excretion, Muscles, Dose levels, Causal interactions, Concentration effects, Osmoregulation, Ion uptake, Ion loss.

Research objective was investigation of effects of gamma ray doses and halide concentrations on rainbow trout survival. Water temperature was maintained at acclimation temperatures and oxygen concentration close to saturation. Fish were irradiated in a cesium-137 (1320 curies) gamma source. After radiation exposure, fish were transferred to experimental units, each with a concentration of sodium halide. Mortality of such irradiated rainbow trout in aquaria, subjected to medium levels of sodium fluoride, sodium chloride, sodium bromide, and sodium iodide, displayed statistically significant responses to following interactions: time by gamma dose, time by sodium halide concentration, or gamma dose by sodium halide concentration. These interactions, apparently caused by radiation, induced changes in oxygen uptake, and in sodium uptake and excretion. Evidence seems to warrant the surmise that mortality early in the experiment resulted from low calcium. The probability that osmoregulatory function is damaged with radiation dose is accepted as an explanation for the pattern of fish mortality in differing salt concentrations. Differential damage to exchange tissues as well as to gill and renal tissues could cause apparent interactions between dose and time or concentration. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07849

STRONTIUM-CALCIUM RELATIONSHIPS IN AQUATIC FOOD CHAINS,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Environmental Research Branch.
I. L. Ophel, and J. M. Judd.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 221-225. 4 tab, 13 ref.

Descriptors: *Strontium radioisotopes, *Calcium, *Food chains, *Lakes, *Spectrometers, *Fish, Perches, Bullheads, Lake Huron, Ontario, Canada, Carp, Suckers, Ecosystems, Radioactivity, Biota, Streams, Genetics.
Identifiers: *Stable strontium, Bone, Perch Lake (Ont), Canada, Dorosoma cepedianum, Kincardine (Ont), Brasenia schreberi, Ponteceria cordata, Typha angustifolia, Nuphar variegatum, Ratios, Numphea odorata, Fontinalis, Potamogeton pusillus, Stomach, Bottom organisms.

This research was undertaken to determine differences in strontium content of fish from two lakes and to investigate causes for these differences. In waters chronically contaminated with strontium-90 (Sr-90), the amount of the radio-nuclide incorporated into fish tissues is directly related to the stable strontium content. Human intakes of Sr-90 will differ in same manner as the stable element. Different species of fish from the same lake and identical species in different lakes were found to have marked variations in stable strontium content. No corresponding variation in calcium contents was found. Two plant species seem to draw on supplies of stable strontium which are not in equilibrium with the water compartment of the ecosystem. Food organisms in lakes have marked differences in strontium (Sr) and calcium (Ca) content and Sr/Ca ratios. Stomach contents analyses indicate a correlation between Sr/Ca ratios in food and those in fish. It appears that differences in stable strontium (and radiostrontium) content among fish are dependent on feeding habits of the species and may indicate that individual fish form feeding habits that persist throughout their life, or that there exist genetic characteristics related to Sr/Ca metabolism in the fish. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07850

SEDIMENT RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY,
Oregon State Univ., Corvallis. Dept. of Oceanography.
C. David Jennings, and Charles Osterberg.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 300-306. 4 fig, 1 tab, 7 ref, disc.

Descriptors: *Sediments, *Radioactivity, *Columbia River, *Estuaries, *Gamma rays, Ecosystems, Biota, Pacific Ocean, Sands, Zinc radioisotopes, Chromium, Benthos, Plankton, Nekton, Flocculation, Oregon, Washington, Sampling.
Identifiers: Radionuclides, Detector, Analyzer, Probe, Hanford (Wash), Half-life.

Because radioactivity concentrates in sediments, a study of this phase was made of the Columbia River estuary. Surface layer of sediments, containing most of the man-made radionuclides, is difficult to remove in its undisturbed state, in quantities suffi-

cient for radioanalysis. An in situ probe circumvents these problems, making possible rapid data collection allowing quick assessment of radioactivity distribution. Radioactivity thus measured closely corresponds with that which benthic organisms experience. Chromium-51 and zinc-65 had the highest concentrations of the radionuclides identified, although naturally occurring potassium-40 was ubiquitous while cobalt-60 and manganese-40 were prevalent. Sediment radioactivity exceeded an order of magnitude higher than that of the water, subjecting benthic organisms in this sediment to a considerably higher radiation dose than the plankton or nekton living in the water above. Distribution of sediment radioactivity (fine sediments contain highest concentrations) depends on (1) contact with radioactive water, (2) the current regime set up by river flow, tidal action, and estuary shape, (3) flocculation of colloidal suspension upon contact with ocean water, (4) sediment particle size and composition, and (5) chemical form of the radionuclide as modified by its immediate environment. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07851

RADIOSTRONTIUM UPTAKE IN BLOOD AND FLESH IN BLUEGILLS (LEPOMIS MACROCHIRUS),
Oak Ridge National Lab., Tenn. Health Physics Div.
J. R. Reed, and D. J. Nelson.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 226-233. 3 fig, 2 tab, 10 ref, disc.

Descriptors: *Strontium radioisotopes, Environmental effects, Ponds, Springs, Sinks, Autoradiographs, Environment, Sunfishes.
Identifiers: *Lepomis macrochirus, *Blood, *Flesh, *Uptake, Half-life, Bones, Scales, Concentrations, White crappie, Excretion patterns.

Radiostrontium in fish flesh is important. The rapid initial uptake of radio-strontium by bluegills (Lepomis macrochirus) was attributed to a quickly exchanged strontium (Sr) pool in flesh and blood. 2% Sr pool in blood consisted of a component having a biological half-life of 2 hours. Another 1% of blood Sr exchanged in 35 days and 97% was contained in a component with a long, undetermined biological half-life. Strontium in blood contributed less than 0.09% to Sr in flesh. At least three compartments of Sr metabolism were identified in flesh. 1% Sr in flesh was turned over with a biological half-life of about 2 hours, while 9% was turned over with a half-life of 9 days. Remaining 90% of Sr in flesh had a long but undetermined half-life. Uptake of Sr in the quickly exchanged Sr pool was directly proportional to Sr concentrations in test solutions in range 0.3-300 parts per billion (ppb). At 3,000 and 30,000 ppb Sr, bluegills took up more Sr than at lower concentrations, indicating non-discrimination against Sr at abnormally high environmental concentrations. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07852

EFFECT OF HANFORD REACTOR SHUTDOWN ON COLUMBIA RIVER BIOTA,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
D. G. Watson, C. E. Cushing, C. C. Coutant, and W. L. Templeton.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 291-299. 8 fig, 23 ref, disc.

Descriptors: *Biota, *Columbia River, Chromium, Phosphorus radioisotopes, Trophic level, Zinc radioisotopes, Iron, Sediments, Fish, Radioecology, Effluents, Ecosystems, Plankton, Algae, Periphyton, Invertebrates, Adsorption, Phytoplankton, Suckers, Shiners, Caddisflies, Temperature, Flow, Diatoms, Manganese.
Identifiers: *Hanford (Wash), *Reactor, Radionuclides, Assimilation, Ba-La, Half-life, Ptychocheilus oregonensis, Acrocheilus alutaceus, Ulothrix, Cladophora, Prosopium williamsoni.

Closure of the Hanford reactors for an extended period caused rapid and extensive decline in concentration of radionuclides. Chromium-51 (Cr-51) and phosphorus-32 (P-32) decreased two to three orders of magnitude in lower trophic levels. The rapid change of P-32 was probably due to its relative short physical half-life and its rapid turnover in aquatic organisms. This was chiefly a biological process, not merely surface adsorption. Although Cr-51 was abundant, its low concentration in higher levels indicates its minor biological importance. Its relatively high concentrations in plankton, algae, and invertebrates, was probably due to adsorption rather than assimilation. Declines in concentrations of zinc-65 (Zn-65), manganese-54, and iron-59, were much less. Their lesser decline in biota as opposed to river water suggested that these nuclides either are turned over at a very slow rate in the organisms, or that they were available from parts of the ecosystem other than water. In fish P-32 was lost rapidly, Zn-65 slowly. The slower rate of change of radionuclides by fish indicated difference in uptake routes. Near equilibrium concentrations of radionuclides in most river organisms were approached within two or three weeks after resumption of reactor operation. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07853

CESIUM, CESIUM-137, AND POTASSIUM CONCENTRATIONS IN WHITE CRAPPIE AND OTHER CLINCH RIVER FISH,
Oak Ridge National Lab., Tenn. Health Physics Div.
D. J. Nelson.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 240-248. 5 tab, 23 ref, disc.

Descriptors: *Cesium, *Radioisotopes, *Radioactivity, *Fish, *Potassium, *Tennessee, Drums, White bass, Channel catfish, Seasonal, Strontium radioisotopes, Gamma rays, Spectrometers, Perches, Trophic level, Pikes, Bullheads, Marine fish, Sunfishes.
Identifiers: *Pomoxis annularis, *Clinch River (Tenn), *Concentrations, Biosphere, Environmental pathways, Biogeochemical, Calcium, Half-life, Flounder, Internal organs, Dorosoma cepedianum, Micropterus salmoides, Lepomis macrochirus, Crappies.

Concentration factors are a convenient parameter to compare biogeochemical relationships. Potassium (K) concentrations in white crappie were relatively constant throughout the year and all specimens averaged 3.48 milligrams/gram fresh weight. Other species, including drum, white bass, channel catfish, bluegill, contained similar K concentrations, and the K content was considered a conservative property. Cesium (Cs) concentrations in white crappie flesh were about 0.008 microgram/gram fresh weight from May through July, and during the remainder of the year varied from 0.010 to 0.018 micrograms/gram. In addition to seasonal variations, the Cs content of different species ranged from 0.00344 micrograms/gram in bluegill to 0.0160 in white bass. Concentration factors for K were from 2500 to 2700, while those for Cs were from 140 to 640. The average specific activity of Cs-137 in white crappie flesh was about the same as the average specific activity in Clinch River water. These results showed that specific activities of Cs-137 may be used to predict its concentration in fish for chronic releases of Cs-137 to surface streams. The variable Cs content and the constant K content of fish vitiates application of Cs-137 to K ratios for predictive purposes. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07854

ACCUMULATION AND DISTRIBUTION OF Mn-54 AND Zn-65 IN FRESHWATER CLAMS,
California Univ., Livermore. Lawrence Radiation Lab.
Florence L. Harrison.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 198-220. 18 fig, 7 tab, 17 ref, disc.

Descriptors: *Clams, *Fresh water, *Manganese, *Radioisotopes, *Zinc radioisotopes, *Distribution, Water, Temperature, Size, Radioactivity, Gonads, Nuclear explosion, Retention, Spectrometers, California.
Identifiers: *Accumulation, Half-life, Calcareous tissue, Digestive tract, Muscles, Excretory organs, Mantle, Gills, Removal, Concentration, San Joaquin River (Calif), Sacramento (Calif), Detector, Labial palps, Foot, Body wall, Body fluid, Lawrence Radiation Laboratory, Heart, Kidney, Uptake, Loss.

Accumulation and distribution of manganese-54 and zinc-65 in freshwater clams was followed for 147 days in an aquarium system designed to maintain constant concentrations of manganese and zinc. Amounts of the radionuclides increased linearly during the uptake period. Concentrations of manganese-54 and zinc-65 showed variation from tissue to tissue, but concentrations within a given tissue were equivalent. After about 100 days, steady-state accumulation and loss were reached in digestive tract, gonad, muscles, and excretory organs. However, in calcareous tissue, mantle and gills, steady-state conditions were not reached in 147 days. Rates of accumulation were found to depend on concentrations of stable element in water, temperature, and sizes of animals. Loss rate of stable element from the clam body was slow: the large long-lived pool of manganese having a half-life of about 1300 days; that of zinc, 650 days. Measurements of specific activities indicated that in all parts of the body, a large fraction of manganese and zinc was in pools with which the radionuclides did not exchange. The main storage site in the body for manganese and zinc (as well as calcium) was in granules in the calcareous tissue. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07855

CONCENTRATION OF SODIUM BY FRESH WATER TURTLES,
Pennsylvania State Univ., University Park. Dept. of Biology.
William A. Dunson.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 191-197. 3 fig, 2 tab, 14 ref, disc.

Descriptors: *Radioisotopes, *Cycling nutrients, *Fresh water, *Environment, *Sodium, *Turtles, Electrolytes, Cloaca (Zoological), Fish, Ecosystem, Ion exchange, Chlorides, Potassium, Electrochemistry, Habitats, Frogs, Enzymes, Proteins, Calcium.
Identifiers: *Organisms, *Concentration, Pharynx, Zinc, Pseudemys scripta, Terrapene carolina, Influx, Uptake, Trionyx spinifer, Mucosa, Serosa, Plasma.

Food has been considered to be the primary route of electrolyte uptake in aquatic turtles. Recent investigations of ion fluxes in freshwater turtles (Trionyx and Pseudemys) indicate there can be a significant uptake of sodium (Na) from the environment by means of active transport. Influx measurements in the intact animal and studies of membranes in vitro in an Ussing cell indicated that transport was localized in membranes of the oral and cloacal regions. Na uptake is an important feature of the adaptation of these animals to fresh water, particularly in areas with cold winters. Hibernating turtles in the laboratory or in nature lose large amounts of Na which must be replaced upon emergence by feeding and by active uptake of ions. The mechanism of uptake also appears to be of general use at other times of the year, especially when food intake is reduced. Toxic effects of zinc seemed evident. Freshwater turtles have developed mechanism for Na uptake very similar to ion transport systems found in fish and amphibians. In light of this and their long evolutionary history in aquatic habitats, turtles should be studied further to determine their importance in concentration of dissolved radioisotopes. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07856

CESIUM-137 IN SOME COLORADO GAME FISH, 1965-66,
Colorado Dept. of Game, Fish and Parks; and Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology.
Wesley C. Nelson, and F. Ward Whicker.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 258-265. 2 tab, 23 ref, disc.

Descriptors: *Cesium, *Radioisotopes, *Fish, *Colorado, Reservoirs, Lakes, Streams, Elevation, Depth, Conductivity, Potassium, Sunfishes, Trout, Salmon, Climates, Soils, Limnology, Physiological ecology, Biological properties, Ecosystems, Latitudinal studies, Precipitation (Atmospheric), Alpine, Rainbow trout, Brown trout, Cutthroat trout, Brook trout, Lake trout, Fallout, Nuclear explosions, Deer, Temperature, Plankton.
Identifiers: Muscle, Area, Pomoxis nigromaculatus, Plains, Foothills, Physiography, Half-life, Lepomis.

During 1965-1966, cesium-137 (Cs-137) concentration in eight game fish species from Colorado waters varied from non-detectable (less than 50) to 5800 picocuries/kilogram. Waters sampled included-3 plains; 2 foothills, 5 montane and 12 alpine reservoirs, lakes, and one plains stream. Elevation of these waters varied from 1538-3498 meters; lake depths, from 1-45 meters; lake areas, from 1.4-230 hectares; lake watershed areas, where measured, from 53-2480 hectares. Conductivity of waters varied from 8-1700 micromhos; potassium concentration, from 0.1-10.3 parts per million. Based on six samples, Cs-137 concentrations were from 2-7 times greater in 1965 than 1966. In general, sunfish, crappies and trout sampled from plains and foothills reservoirs, lakes, and the river contained little or no Cs-137. Trout and salmon from a montane reservoir and one lake contained low or moderate concentrations of Cs-137, whereas those from another montane lake had high concentrations. Trout from alpine lakes and reservoirs contained moderate to high concentrations of Cs-137. Cs-137 concentrations in fish from different waters varied chiefly according to climatic, edaphic and limnological conditions; between species, such concentrations varied with differences in biology and physiology of the species. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07857

RADIOACTIVE AND STABLE STRONTIUM ANALYSIS OF UPPER MISSISSIPPI RIVER CLAMSHELLS,
Saint Mary's Coll., Winona, Minn. Dept. of Biology.
George Pahl.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 234-239. 2 fig, 3 tab, 13 ref, disc.

Descriptors: *Strontium radioisotopes, *Mississippi River, *Clams, *Fresh water, Benthic fauna, Fallout, Monitoring, Calcium carbonate, Nuclear explosions, Rain, Spectrophotometers, Indicators, Nutrients, Environment, Milk, Wheat, Soils, Minnesota.
Identifiers: Strontium carbonate, Shells, Half-life, Biosphere, Bones, Teeth, Lake Pepin (Minn), Stratosphere, Tap water.

Freshwater clams form a significant portion of the benthic fauna of the Upper Mississippi River biological community. Evidence indicates that they may serve as ideal biological monitors of strontium-90 (Sr-90) concentration not only in the Upper Mississippi River but also of worldwide fallout of this radionuclide. Advantage was taken of the fact that shells of the long-lived clams of this area are composed of distinct annual layers and are chemically composed of calcium and/or strontium carbonate almost exclusively. Shells of live clams of genus Lampsilis collected at end of the 1962-4 growing season were analyzed for both stable and radioactive strontium. Shell layers formed over the ten-year period, 1955-64, showed stable strontium to be consistently 10 orders of magnitude greater than that of radioactive strontium. During this time, stable strontium increased by a factor of only 2, while the Sr-90 increased by a factor of 7. This rise of radiostrontium, while not corresponding with overall strontium increase, did correlate closely with the fallout pattern associated with nuclear weapon testing carried out during this period. Results compare favorably to similar analyses of fallout. (See also Vol. 2, No. 18, Field 5C, W69-07441) (Jones-Wisc)
W69-07858

A TRACER EXPERIMENT WITH I-131 IN AN OLIGOTROPHIC LAKE,
Helsinki Univ. (Finland). Dept. of Radiochemistry.
S. Kolohmainen, S. Takatalo, and J. K. Miettinen.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 278-284. 6 fig, 2 tab, 11 ref, disc.

Descriptors: *Oligotrophy, *Lakes, *Iodine radioisotopes, *Tracers, Ecosystems, Algae, Water analysis, Temperature, Depth, Humic acids, Zooplankton, Perches, Bogs, Pine trees, Fir trees, Cesium, Oxygen, Mud, Rainbow trout, Fallout, Nuclear explosions.
Identifiers: *Finland, Spongilla lacustris, Sphagnum recurvum, Nephar lutea, Cyprinus carassius, Oedogonium, Dysoligotrophy, Bottom animals, Heath, Analyzer, Half-life, Concentration factor.

A tracer experiment with iodine-131 in a natural oligotrophic lake was carried out to provide quantitative information on distribution of this fallout nuclide in all components of a natural ecosystem. Iodine-131 (17 millicuries) was pumped from a moving boat and efficiently mixed within 100 minutes into the lake of 23,000 cubic meters. Samples of water, plants, a sponge, and three species of fish, were collected during 41 days. Results showed that peak radioactivity was reached in all organisms: algae, water plants, a sponge (Spongilla lacustris), and fish (crucian carp (Cyprinus carassius), perch (Perca fluviatilis), rainbow trout (Salmo gairdneri)), within 5 to 7 days. The effective half-time of radioactivity in the lake water was 6.5 days; that of the added element, iodine, 36 days. Main factor in removing iodine from the water was the moss (Sphagnum). Concentration factors calculated by comparing the peak radioactivity of the organism to the initial radioactivity in the water (nannocuries/killogram fresh weight per nannocuries/liter water) were: sponge 200, green algae 200, moss 90, water lily (Nuphar luteum) 60, crucian carp 25. The animal species showed the longest biological half-lives for iodine. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wisc)
W69-07859

CESIUM-137 IN FRESHWATER FISH DURING 1954-1965,
Division of Biology and Medicine (AEC), Washington, D. C.
Philip F. Gustafson.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 249-257. 3 fig, 2 tab, 6 ref, disc.

Descriptors: *Cesium, *Freshwater fish, *Fallout, Perches, Walleye, Spectrometers, Minnesota, Gamma rays, Ecosystems, Bottom sediments, Trophic level, Sinks, Sampling, Birds, Plankton, Scaling, North Dakota, Wisconsin, Nuclear explosions, Precipitation (Atmospheric), Radioactivity.
Identifiers: Half-life, Body burden, Deposition, Argonne National Laboratory, Contamination, Red Lakes (Minn.

Concentrations of cesium-137 (Cs-137) from world-wide fallout have been measured in small perch and walleyes by gamma ray spectrometry. Annual collections were made during each July (1954-1965) from the same approximate location. Deposition rate and total accumulation of Cs-137 in the area were derived from regional data by making corrections for differences in local precipitation. Cs-137 levels changed fairly rapidly in response to changes in fallout rate; however, there was a substantial contribution from accumulated deposition in the aquatic ecosystem which acts as a sink. Solution of a mathematical expression relating the concentration of Cs-137 in fish to the total amount of Cs-137 present in the lake, and its rate of deposition, indicated that 25-80% of that found in fish came from the long-term accumulation. This accumulation was the more important source for Cs-137 fish uptake during periods of low fallout rate. Effective half-time for Cs-137 in the lake system, as inferred from small fish, was about two-and-a-half years. Persistence of Cs-137 in a freshwater system differs sharply from the behavior of terrestrial levels. The continuing availability of Cs-137 to freshwater fish suggests its accessibility to human diet for some time. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wisc)
W69-07860

THE ROLE OF TUBIFICID WORMS IN THE TRANSFER OF RADIOACTIVE PHOSPHOROUS IN AN AQUATIC ECOSYSTEM,
Western Michigan Univ., Kalamazoo.
Bert K. Whitten, and Clarence J. Goodnight.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 270-277. 2 fig, 2 tab, 20 ref.

Descriptors: *Tubificids, *Ecosystems, *Phosphorus radioisotopes, *Transfer, Water, Bacteria, Sediments, Minnows, Detritus, Cycling nutrients, Plankton, Algae, Invertebrates, Turbidity, Worms, Sunfishes.

Identifiers: Radioautographs, Half-life, Concentration factor, Limnodrilus spp, Aeolosoma hemprichi, Escherichia coli, Myriophyllum, Lepomis macrochirus, Pimephales notatus.

Accumulation of radiophosphorus by tubificid worms (common habitat bottom sediments of streams and lakes) from water, bacteria, and sediment, was studied. Tubificid worms took up more phosphorus from water and bacteria than from sediment. These worms were able to accumulate phosphorus from both soluble and organic particulate sources. Radioautographs demonstrated that much of the activity was in the tissues of these worms and not simply adsorbed. No significant accumulation from radioactive orthophosphate, which was adsorbed onto sterile sediments, was observed. Bluegills and bluntnose minnows fed tubificid worms labelled with radiophosphorus accumulated radiophosphorus in their tissues. Theoretical calculations based on these feeding studies demonstrated that an equilibrium was approached after two weeks in the tissues of these fish and was maintained through the duration of the experiment. Tubificid worms, because of their abundance in some aquatic ecosystems, may have an important role in transfer of radioactive phosphorus from water and detritus to other components of the aquatic ecosystem, such as fish. These worms appear to function in conjunction with bacteria in the recycling of radiophosphorus from detritus and sediments. This experimentation is intended to suggest possible relationships which may occur in the environment. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wisc)
W69-07861

RADIONUCLIDE CYCLING BY PERIPHYTON: AN APPARATUS FOR CONTINUOUS IN SITU MEASUREMENTS AND INITIAL DATA ON ZINC-65 CYCLING,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
C. E. Cushing, and N. S. Porter.
Available from Clearinghouse as CONF 670503 at $3.00 in paper copy and $0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF-670503, pp 285-290. 3 fig, 1 tab, 12 ref.

Descriptors: *Periphyton, *Cycling nutrients, *Zinc radioisotopes, Streamflow, Sampling, Algae, Ecosystems, Environment, Retention, Photoperiodism, Light intensity, Velocity, Temperature, Chemical analysis, Physiological ecology, Oxygen, Carbon dioxide, Carbon radioisotopes, Detritus, Columbia River, Electronics, Scaling.
Identifiers: *Radionuclide, Ulothrix, Uptake, Half-life, Detector.

This part of the Columbia River program concerns the role of the periphyton community in cycling radionuclides. Difficulties in studying a large river with extremely unstable hydrography have led to development of a system having advantages of laboratory controlled experiments while maintaining some semblance of natural conditions. It permits the continuous measurement of uptake and cycling of radionuclides between stream periphyton and a controlled aqueous environment. The system was designed to avoid inherent difficulties in aquaria studies, that is, the necessity of destroying or sub-sampling the community for sequential analyses, the lack of a continuous flow of water over algae to simulate stream conditions, and inability to maintain a fixed ambient radionuclide concentration because of immediate uptake and recycling by the organisms. Apparatus permits evaluation of the effect of individual physical and chemical environmental factors in either an open one-pass system or in a closed recirculating system. Preliminary results of six uptake and two retention experiments using zinc-65 in the closed system are presented. Despite community type, that is mature or 'young', the time of approximate equilibrium is around 20 hours and the activity accumulated on a weight basis is about 0.021 nanocuries/milligram dry weight. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wisc)
W69-07862

RADIOECOLOGY.
Division of Biology and Medicine (AEC), Washington, D. C.

Proc 1st Natl Symp Radioecology, Colo State Univ, Fort Collins, Sept 10-15, 1961. Schultz, Vincent and Klement, Jr, Alfred W (eds). Reinhold Publishing Corp, New York, and Amer Inst Biol Sci, Washington, DC, 1963. 746 p, 294 fig, 261 tab, 2,476 ref, 2 bibliog.

Descriptors: *Conferences, *Radioecology, Fallout, Biological communities, Environmental effects, Ecosystems, Environment, Population, Radioactive waste disposal, Radioactivity, Radioactivity effects, Radioisotopes, Vegetation, Water pollution sources, Water pollution effects, Computer models, Colorado, Food chains, Insects, Fish, Mammals, Plankton, Oceanography, Birds, Limnology, Tracers, Bibliographies, Training.
Identifiers: *Proceedings, Animal sciences, Ecological techniques, Freshwater environments, Nevada Test Site, Marine environments, Plants sciences, Radionuclide cycling, Soil sciences, Terrestrial environments, Fort Collins (Colo).

Volume comprises proceedings of symposium organized to integrate current information in radioecology. Compendium includes text of introductory speaker, 'Impact of Atomic Energy on the Environment and Environmental Science,' and general review papers: 'Radiation Effects and Peaceful Uses of Atomic Energy in the Plant and Soil Sciences,' 'Radiation Effects and Peaceful Uses of Atomic Energy in the Animal Sciences,' 'Continental Close-In Fallout: Its History, Measurement and Characteristics,' 'Disposal of Radioactive Wastes: Its History, Status and Possible Impact on the Environment.' Additional sections (number of contributions per section in parentheses) are entitled: Cycling and Levels of Radionuclides in the Terrestrial Environment (13), Cycling and Levels of Radionuclides in the Marine Environment (12), Cycling and Levels of Radionuclides in the Freshwater Environment (5), Effects of Ionizing Radiation on Plants and Animals in Terrestrial Environments (16), Effects of Ionizing Radiation on Plants and Animals in Marine and Freshwater Environments (6), Ecological Techniques Utilizing Radionuclides in Terrestrial Environments (9), Ecological Techniques Utilizing Radionuclides in Marine and Freshwater Environments (5), Occurrence, Effect and Utilization of Nuclides in the Environment (16). Appendices include: panel report on education and research training and two bibliographies (2,452 entries altogether). Those contributions relevant to aquatic ecosystems will be abstracted separately. (Eichhorn-Wisc)
W69-07863

LETHAL OXYGEN CONCENTRATIONS FOR TROUT AND SMALLMOUTH BASS,
New York State Dept. of Conservation.
G. E. Burdick, Morris Lipschuetz, Howard F. Dean, and Earl F. Harris.
N Y Fish and Game J, Vol 1, No 1, pp 84-97, January 1954. 4 fig, 4 tab, 11 ref.

Descriptors: *Bass, *Environmental effects, *Lethal limit, *Oxygen, *Trout, Estimating equations, Eutrophication, Fishkill, New York, Oxygen demand, Organic wastes, Regression analysis, Temperature, Water chemistry, Water pollution effects, Water quality.
Identifiers: Beebe Lake (N Y), Deer River (N Y), Grout Brook (N Y), Hypoxic environments, Micropterus dolomieu, Rochester (N Y), Rome Fish Hatchery (N Y), Salmo gairdnerii, Salmo trutta, Salvelinus fontinalis, Winkler method.

Sensitivity of fishes to environmental hypoxia increases with rising temperature. Authors constructed curves describing this relationship for trout (brook, brown, and rainbow) and smallmouth bass by plotting mean LOC (lethal oxygen concentration) against temperature on semi-logarithmic paper and fitting the best linear regression line to the plot. They determined LOC by a procedure involving gradual respiratory reduction of oxygen in sealed containers, using loss of equilibrium as an end-point. Highest and lowest concentrations producing such effects were recorded. Regressions so obtained (with temperature ranges, in degrees Fahrenheit, indicated in parentheses) are as follows: brook trout (55-70), Log Y= 0.0135X - 0.54326; brown trout (49-69), Log Y= 0.01248X - 0.46056; hatchery rainbow trout (52.0-71.1), Log Y= 0.01145X - 0.55783; wild rainbows (52-68), Log Y= 0.00979X - 0.48858; Deer River smallmouth bass (54-80), Log Y= 0.00723X - 0.51936; Beebe Lake bass (52.5-80.0), Log Y= 0.00842X - 0.64366, where Y is mean LOC in parts/million, and X is temperature in degrees F. Report includes tabular data bearing on maximum, minimum, median, and mean LOC, with standard deviations and standard errors for the latter. Authors present evidence that their procedures approximate rapid decreases of oxygen in streams intermittently receiving organic wastes. (Eichhorn-Wisc)
W69-07864

THE SUBMERGED AQUATICS OF UNIVERSITY BAY: A STUDY IN EUTROPHICATION,
Wisconsin Univ., Madison. Dept. of Botany.
Christopher T. Lind, and Grant Cottam.
Amer Midland Naturalist, Vol 81, No 2, pp 353-369, April 1969. 4 fig, 6 tab, 17 ref.

Descriptors: *Submerged plants, *Eutrophication, Wisconsin, Aquatic plants, Bioindicators, Water pollution effects, Biological communities, Environmental effects, Floating plants, SCUBA diving, Oligotrophy, Plant growth, Biomass, Phenology.
Identifiers: *University Bay (Wisc), *Lake Mendota (Wisc), Dane County (Wisc), Madison (Wisc), Myriophyllum exalbescens, Potamogeton amplifolius, Potamogeton illinoensis, Compositional gradient (Swindale-Curtis), Ceratophyllum demersum, Compositional indices, Sand bar (Scirpus) community, Floating leaved community, Vallisneria community, Shallow submerged community, Myriophyllum-Vallisneria community, Myriophyllum community, Species frequency, Species diversity, Species density, Vallisneria americana.

Authors studied submerged aquatic plants in Lake Mendota, Wisconsin, by sampling 21 transects, extending perpendicularly from the shore to that point in University Bay where their growth ceased. All plants intercepting the line were recorded within consecutive half-meter linear segments. Data were used to construct a contour map of vegetated portions of bay and to delimit six plant communities found there. Samples collected biweekly from four quadrats provided information on plant heights and standing crops. Report includes following tabulated data: variation in depth of plant growth; species list by relative and percentage frequency; species composition and Compositional Indices for six communities; average densities by quadrat; 1922 species list; and quantitative changes (45 years) in species composition. Collected data were compared with studies made in 1922. Marked changes in vegetation have occurred, the principal differences being a great increase in Myriophyllum exalbescens, and disappearance of Potamogeton amplifolius and P illinoensis, former major components of the vegetation. Based upon a quantitative compositional gradient of 400 points, representing lakes from oligotrophic to eutrophic, this bay has reached its ultimate limit of eutrophication, and its future is apparently one of decreasing species complexity and increasing problems to human users. (Eichhorn-Wisc)
W69-07866

SOME LIME-INDUCED CHANGES IN LAKE METABOLISM,
Wisconsin Univ., Madison. Lab. of Limnology.
Raymond G. Stross, and A. D. Hasler.
Limnology and Oceanography, Vol 5, No 3, pp 265-272, Nov 1964. 5 fig, 2 tab, 18 ref.

Descriptors: *Cycling nutrients, *Lakes, *Lime, Bicarbonates, Calcium, Colloids, Dystrophy, Eutrophication, Iron, Light penetration, Limnology, Magnesium, Organic matter, Oxygen demand, Phosphorus, Water chemistry, Water quality, Wisconsin.
Identifiers: *Experimental limnology, Bog lakes, Iron cycle.

Hydrated lime was applied to lakes George, Corrine, and Peter, in northern Wisconsin, utilizing Paul Lake as an untreated natural reference. These bog-type, dystrophic lakes are all slightly acid and stained with organic colloids. Light penetration increased in all treated lakes; depth of euphotic zone increased by 22% in George, 40% in Corrine, 60% in Peter. After six weeks, pH of George Lake had decreased from 9.4 to 7.2, immediately after treatment. Because lime does not remove all colloids equally well, light penetration alone may not adequately indicate change in degree of dystrophy. Lime may efficiently precipitate only more unstable colloids, whereupon oxygen demand may decrease without measurably influencing water clarity. Data included in report suggest that normal precipitation of phosphorus by iron was unaffected by treatment of Peter Lake. (Eichhorn-Wisc)
W69-07868

LIMITATION OF NUTRIENTS AS A STEP IN ECOLOGICAL CONTROL,
Wisconsin Univ., Madison. Hydraulic Lab.; and Wisconsin Univ., Madison. Sanitary Lab.
Gerald W. Lawton.
Trans of Seminar on Algae and Metropolitan Wastes, Robert A Taft San Eng Center, Cincinnati, Ohio, TR W61-3, pp 108-117, April 27-29, 1960. 12 fig, 3 tab, 15 ref.

Descriptors: *Nutrients, *Eutrophication, *Sewage effluents, Nitrogen, Phosphorus, Wisconsin.
Identifiers: *Ecological control, *Effluent diversion, *Diversion effects, *Madison lakes, Algal nuisance, Odor nuisance, Nutrient sources, Chemical studies, Inorganic nitrogen, Organic nitrogen, Soluble phosphorus, Volatile suspended solids, Algae sample concentration, Algae species diversification, Madison (Wis), Lake Mendota (Wis), Lake Monona (Wis), Lake Wingra (Wis), Lake Kegonsa (Wis), lake Waubesa (Wis), Biological studies.

Algal nuisance and odor problem plagueing Madison lakes for years, was first attributed (1920) to decomposition of abundant algal blooms, promoted by nutrients contained in municipal and industrial wastes. The Governor's Committee (1943), determined that Madison's sewage plant effluent contributed the bulk of nutrients to Lakes Waubesa and Kegonsa. By 1958, a 1943 legislative bill was implemented and effluent diverted via Badfish Creek to a point below the Madison lakes. From average flow of the Yahara River and the calculated volumes for Lakes Waubesa and Kegonsa, it was projected that diversion would eliminate the overenrichment rapidly; however actual reduction of this overenrichment was considerably less due to trapped nutrients in bottom muds and incomplete mixing. To evaluate effects of diversion, chemical and biological studies have been conducted since 1959, utilizing twelve data collection stations from Lake Mendota to lower Badfish Creek. Graphs of inorganic nitrogen, organic nitrogen, soluble phosphorus, and volatile suspended solids, for each lake during 1922-1959, show the effects of diversion on each parameter. Data concerning plankton species diversification during 1955-1959 show Lakes Monona and Kegonsa had no appreciable change while in Lake Waubesa, number of species increased sharply after diversion. (Ketelle-Wis)
W69-07869

LAKE LYNGBY SO: LIMNOLOGICAL STUDIES ON A CULTURALLY INFLUENCED LAKE,
Copenhagen Univ., Hillerod (Denmark). Freshwater-biological Lab.
Sigurd Olsen.
Folia Limnologica Scandinavica, No 7, 157 p, 1955. 63 fig, 13 tab, 310 ref.

Descriptors: *Eutrophication, *Limnology, *Lakes, Sediments, Nutrients, Aquatic productivity, Bottom sediments, Chemical properties, Diurnal distribution, Water analysis, Hydrology, Annual turnover, Vegetation, Stratification, Sewage effluents, Human population, Water pollution sources, Water pollution effects, Water chemistry, Silicon, Chlorides, Nitrogen, Calcium, Phosphorus, Oxygen demand, Oxygen, Hydrogen ion concentration, Temperature, Optical properties.
Identifiers: *Lake Lyngby So, Cultural eutrophication, Fura River, Denmark.

Situation and character of environs of Lake Lyngby So are described from the point of view of physical ancd chemical limnology, cultural history and biology. The increase in population around the lake is taken as an indicator of intensified eutrophication. Hydrology of the lake, influences on conditions of runoff and subsoil water, are mentioned, including clearing of forests and intensification of agriculture. Composition of the water changes upon passage through the lake, and chemical composition of the waters which were not directly connected with the lake differs from that of lake. Annual variation of temperature, transparency, color, dissolved oxygen, pH, alkalinity, calcium, phosphorus, silicon, chloride, nitrogen, and oxygen consumption is demonstrated with diagrams of surface and deep water samples. The occurrence of summer and winter stagnation under special conditions can be accentuated by incomplete mixing of water from River Fura. Diurnal variation, influenced by weather conditions, has been demonstrated for temperature, pH, and oxygen. The physical and chemical variations in bottom muds are illustrated. (Bortleson-Wisc)
W69-07870

CHLORINATED HYDROCARBON PESTICIDES IN CALIFORNIA BAYS AND ESTUARIES,
California State Dept. of Fish and Game, Menlo Park. Marine Resources Operations.
For primary bibliographic entry see Field 05B.
W69-07920

A SYMPOSIUM ON ESTUARINE FISHERIES.
American Fisheries Society, Washington, D. C.
For primary bibliographic entry see Field 02L.
W69-07986

WASTES IN RELATION TO AGRICULTURE AND FORESTRY,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
Cecil H. Wadleigh.
Dep Agr Misc Publication No 1065, Mar 1968. 112 p, 1 fig, 4 tab, 139 ref, 4 append.

Descriptors: *Water pollution sources, *Water pollution effects, *Agriculture, *Forestry, Agricultural chemicals, Fertilizers, Pesticides, Farm wastes, Farm management, Organic wastes, Industrial wastes, Forest management, Sediment load, Microorganisms.
Identifiers: Farm and forestry wastes.

The sources and effects of wastes contributed to air, water, and soil by agricultural and forestry management practices are briefly discussed. The major waste categories considered are radioactivity, chemical air pollutants, airborne dusts, sediments, plant nutrients, inorganic chemicals, organic wastes, infectious agents, allergens, industrial and agricultural chemicals, and heat. A bibliography of 139 entries is included. Appendices discuss wastes adversely affecting agriculture and forestry, research on waste management, and problems in waste management needing more attention. (Knapp-USGS)
W69-08029

A CONTINUED PRE- AND POSTIMPOUNDMENT SURVEY OF THE HELMINTH AND CRUSTACEAN PARASITES OF MICROPTERUS DOLOMIEUI LACAPEDE, M. PUNCTULATUS (RAFINESOUE) AND M. SALMOIDES (LACEPEDE) (PERCIFORMES) OF BEAVER RESERVOIR IN NORTHWESTERN ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W69-08121

5D. Waste Treatment Processes

COMPUTER AIDED DESIGN OF WASTE WATER COLLECTION AND TREATMENT SYSTEMS,
Michigan Univ., Ann Arbor. Dept. of Environmental Health.
Rolf A. Deininger.
Mich Univ School Public Health Final Rep to OWRR, Feb 1969. 15 p, 5 fig, 12 ref. OWRR Proj No. A-108-MICH.

Descriptors: *Waste water treatment, *Systems analysis, *Optimization, *Sewers, *Design, Network design, Hydraulic design, Mathematical models, Digital computers, Design criteria, Model studies, Research and development.
Identifiers: Sewage treatment design.

Systems analysis techniques were studied as an aid in the design of waste water collection and treatment systems. The research was in the optimum design of sewer systems, the optimum design of treatment plants, computer-aided conventional plant design, and the feasibility of generating construction plans on automatic plotting equipment. (Knapp-USGS)
W69-07714

THE RECLAMATION OF POTABLE WATER FROM WASTEWATER,
Council for Scientific and Industrial Research, Pretoria (South Africa).
G. J. Stander, and L. R. J. Van Vuuren.
J Water Pollut Contr Fed, Vol 41, No 3, pp 355-367, Mar 1969. 13 p, 11 fig, 1 tab, 8 ref.

Descriptors: Sanitary engineering, *Potable water, Domestic water, Municipal water, Waste treatment, *Waste water treatment, *Waste water, *Water reuse, Water treatment, *Tertiary treatment, Sewage effluents, Sewage treatment, *Water purification, Filtration, Foreign research, Flotation, Pilot plants.
Identifiers: *Waste water reclamation, Waste water use, South Africa.

Research results on potable water reclamation from humus tand effluent and primary clarified waste water are reported by the National Institute for Water Research of the Republic of South Africa. A pilot plant is described for advanced tertiary treatment of waste water plant effluents. The pilot plant has a 1200-gal/hr capacity and consists of: (1) flotation unit, (2) ammonia stripper, (3) stabilizer, (4) sand filter, (5) foam fractionator, (6) chlorination tank, and (7) activated carbon filter. Functions of the units are discussed and test results summarized. Results show that the advanced physical-chemical treatment process can produce potable water from humus tank effluent and primary clarified waste water at an overall cost of $0.25 and $0.31 per 1000 gal, respectively. (USBR)
W69-07772

SPRAY IRRIGATION FOR THE REMOVAL OF NUTRIENTS IN SEWAGE TREATMENT PLANT EFFLUENT AS PRACTICED AT DETROIT LAKES, MINNESOTA,
Larson (Winston C.), Detroit Lakes, Minn.

Winston C. Larson.
PUB SEC TR W61-3. Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, Trans of Seminar on Algae and Metropolitan Wastes, pp 125-129, April 27-29, 1960.

Descriptors: *Sprinkler irrigation, *Sewage treatment, *Nutrients, Phosphorus, Nitrogen, Rates of application, Costs, Eutrophication, Minnesota, Hardness (Water), Water quality control.
Identifiers: *Nutrient removal, Algal growth, Lake study, Alum coagulation, Lime coagulation, Ridge and furrow method, Effluent ponding, Litigation, Ground-water quality, Detroit Lakes, Minnesota.

The history of sewage treatment and disposal, by a resort town in an area of recreational lakes in Minnesota, is described. Investigation of methods of nutrient removal resulted from a lawsuit brought against the city by property owners on a downstream lake in which increasing algal blooms were becoming a nuisance. Minnesota Department of Health made recommendations for a study program of the problem. Consideration was given to the experimental alum coagulation method, studied at the University of Wisconsin, and lime coagulation experiments at Detroit Lakes, by the Minnesota Department of Health. Ponding of effluent was also considered, but irrigation was the method finally selected. Site investigation was carried out to determine soil permeability, effects of vegetation, probability of odors, operating conditions in winter, and effects on ground water. Cost of initial installation (1955) to handle 600 gpm was $6,500. Effect on ground water was determined by before and after samples from a test well which showed a 3' 1" rise in water level in four years; total increases in ppm: phosphorus, 0.6 to 2.9; nitrogen, 2.6 to 33.2; hardness, 300 to 420. Operating costs of the installation are essentially that of power requirements. (Ketelle-Wisc)
W69-07820

THE PHYSIOLOGY OF THE COLIFORM GROUP,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
For primary bibliographic entry see Field 05A.
W69-07835

THE METHANE FERMENTATION,
Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05A.
W69-07837

TRANSFORMATIONS IN INFILTRATION PONDS AND IN THE SOIL LAYERS IMMEDIATELY UNDERNEATH,
Research Institute for Public Health Engineering TNO, The Hague (Netherlands). Water, Soil, and Air Div.
J. K. Baars.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 344-365, 1964. 8 fig, 2 tab, 9 ref, disc.

Descriptors: *Infiltration, *Ponds, *Soil, Groundwater basins, Water supply, Mud, Benthos, Hydrogen, Bacteria, Aerobic bacteria, Metabolism, Canals, Sands, Chlorination, Microorganisms, Chemical analysis, Temperature, Nitrates, Plants, Ammonia, Hardness (Water), Acidity, Oxygen, Algae, Self-purification, Bacteriophage, Reservoirs, Spores, Nitrites, Iron, Organic matter, Subsoil, Velocity, Oxidation, Denitrification, Sulfates, Reduction (Chemical), Fermentation, Methane, Hydrogenation, Chemical oxygen demand, Biochemical oxygen demand, Potassium compounds, Carbon dioxide, Protozoa, Sewage, Sludge, E coli.
Identifiers: *Transformations, Amsterdam, Haarlem, Leyden, The Hague, Mineralization, Clay lenses, Rhine River, Amsterdam Rhine, Polders, Composition, Pseudomonas, Mycobacterium, Bacillus subtilis, Bacillus mycoides, Bacillus mesentericus, Diatomea, Cladophora, Flagellata, Ciliates, Ranunculus circinatus, Potamogeton pusillus.

Water from storage ponds, filtered through bottom mud and a body of sand, was measured for chloride, forms of nitrogen, oxygen, organic matter, algae, and bacterial content. To study benthos, water was analyzed from wells constructed at distances from a pond in the direction of flow. Not only dissolved organic matter, as determined by the potassium permanganate method, is mineralized, but much more oxidant (free oxygen plus nitrate oxygen) is used, apparently in the benthos. The high oxidant consumption indicates that the reduction of organic matter is intense. Organic substances, detectable by taste, are not completely eliminated. When there is a constant supply of new oxidant, dead biological materials may be mineralized aerobically. If this supply is terminated, anaerobic transformations may dominate. Probably bacteria are strongly adsorbed to the sand grains in concentrations resulting in intense struggle for life and decrease rapidly with increasing distance from the pond. Samples from the bottom of the ponds downward showed pronounced decrease in bacteria at 0.5-meter depth. A small amount of silt in the water may cause clogging of the soil. The intermittent infiltration system affords the same permeability of the sand each year with the consequent use of available purifying actors. (See also Vol. 2, No. 18, Field 5C, W69-07423). (Jones-Wisc)
W69-07838

PROTEOLYSIS AND PROTEOLYTIC ORGANISMS,
Wallerstein Co., Staten Island, N. Y.
Samuel R. Green.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 430-440, 1964. 4 tab, 36 ref, disc.

Descriptors: *Microorganisms, *Bacteria, *Hydrolysis, *Proteins, *Synthesis, Fungi, Enzymes, Wastes, Sewage, Nutrient requirements, Amino acids, Sludge, E coli, Metabolism, Effluents, Filters, Biochemical oxygen demand, Milk, Phosphates, Dairy industry, Carbohydrates, Peptides, Streptococcus, Pseudomonas, Aircraft, New Jersey.
Identifiers: *Proteolysis, Streptomyces griseus, Sepedonium, Space, Aerobacter cloacae, Bacillus subtilis, Bacillus mesentericus, Bacillus cereus, Achromobacter delicatulum, Penicillium, Fusarium aquaeductum, Oospora, Phonia, Trichosporon cutaneum, Geotrichum, Nocardia actinomorpha, Paracolobactrum aerogenoides, Escherichia intermedia, Zooglea ramigera, Gelatin, Casein, Glucose, Lactose, Starch, Alcaligenes bookeri, Alcaligenes faecalis, Flavobacterium aquatile, Flavobacterium balustinum, Flavobacterium devorans, Feces, Clarifiers, Bacillus circulans, Bacterium linens, Bacillus endorhythmos, Leuconostoc mesenteroides, Bacillus amyloliquefaciens, Bacillus natto, Clostridium, Aspergillus.

Proteolytic microorganisms and their enzyme systems play important roles in sewage disposal systems and in the closed ecological system which contains a microbial population capable of generating a food supplement from wastes. The cultural characteristics of floc-forming bacteria from activated sludge, intermittent sand filters, and actively assimilating dairy waste sludge, are significant. Certain Bacillus and Bacterium species seem to be responsible for high purification rates and ability of the sludge to remove and store oxygen-demanding substances. No microbial enzymes have been clearly shown to be active only on proteins. All have been found to possess wide ranges of side-chain specificity. Usually, utilizable carbohydrates supply the energy for synthesis of protein and incorporation of amino acids into microbial protein. There is still doubt that microbial ribosomes alone are responsible for peptide bond formation and synthesis of soluble protein. Difficulties remain in relating in vitro incorporation of amino acids into ribosomes to the synthesis of protein in vivo. How deoxyribonucleic acid is involved in synthesis of bacterial enzymes is not yet completely clear. It is difficult to state that there is necessarily one correct series of reactions or one path of protein biosynthesis. (See also Vol. 2, No. 18, Field 5C, W69-07423). (Jones-Wisc)
W69-07842

WASTEWATER RECLAMATION AND EXPORT AT SOUTH TAHOE,
South Tahoe Public Utilities District, South Lake Tahoe, Calif; and Hill (Clair A.), Redding, Calif.
Russell L. Culp, and Harlan E. Moyer.
Civil Eng, Vol 39, No 6, pp 38-42, June 1969. 5 p, 3 photo, 1 tab.

Descriptors: *Water reuse, *Sewage treatment, *Nevada, *California, *Lakes, Waste water disposal, Inter-basin transfers, Water pollution control, Water quality control, Tertiary treatment, Activated carbon, Filtration, Reclaimed water.
Identifiers: *Lake Tahoe.

The 7.5-mgd reclamation plant at the South Tahoe Public Utility District is the most advanced full-scale wastewater treatment plant in the world. Treatment consists of 2 basic parts, liquid processing and solids handling. The first 2 steps of liquid processing are the conventional ones of primary, or solids separation, and secondary, or biological oxidation. In addition, the advanced treatment provides chemical treatment and phosphorus removal, mixed-media filtration, activated carbon adsorption, and disinfection. The solids handling system provides for incineration of biological sludge, regeneration and reuse of granular activated carbon, and recalcining and reuse of lime, all by means of multiple hearth furnaces equipped with scrubbers and afterburners. Results to date indicate that the plant removes all of the suspended solids, color, odor and bacteria; most of the BOD, COD, MBAS, and phosphorus; and 50 to 98% of the nitrogen. Reclaimed water is exported from the Tahoe Basin and used to irrigate croplands. (Knapp-USGS)
W69-07922

ANIMAL WASTES--A NATIONAL PROBLEM,
Cornell Univ., Ithaca, N. Y. Dept. of Agriculture; and Cornell Univ., Ithaca, N. Y. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W69-08010

NITROGEN LOSSES FROM ALKALINE WATER IMPOUNDMENTS,
San Diego State Coll., Calif. Dept. of Civil Engineering.
Frank E. Stratton.
ASCE Proc, J Sanit Eng Div, Vol 95, No SA2, Pap 6495, pp 223-231, Apr 1969. 9 p, 5 fig, 1 tab, 3 ref. Grant No GK-1623 NSF.

Descriptors: *Denitrification, *Ammonia, *Nitrogen cycle, *Eutrophication, Water treatment, Sewage treatment, Water pollution control, Waste water treatment, Lagoons, Biodegradation.
Identifiers: *Nitrogen removal.

Results of an investigation of gaseous ammonia nitrogen losses from alkaline water impoundments are presented. A method of field measurement of these losses is described and a comparison made between rates of loss predicted from a study of impounded water samples with rates of loss obtained by direct field measurement. Results indicate that warm eutrophic impoundments are potentially able to liberate significant quantities of gaseous ammonia nitrogen to the atmosphere due to natural degasification processes. (Knapp-USGS)
W69-08011

CONSERVATION OF WATER BY REUSE IN SOUTH AFRICA,
Council for Scientific and Industrial Research, Pretoria (South Africa).
G. J. Stander, and J. W. Funke.
Water Reuse Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 1-12, 1967. 12 p, 16 fig, 6 tab, 11 ref.

Descriptors: *Water reuse, *Reclaimed water, *Sewage treatment, Industrial wastes, Municipal wastes, Water utilization, Byproducts, Chemical wastes, Pulp wastes.
Identifiers: *South Africa, Breweries, Vaal River (S. Africa).

The present water potential for urban, industrial, and agricultural development in South Africa is only 900 gal/person/day, as compared with the 3,700 gal/person/day in the USA. The reuse of water in South Africa, especially in highly industrialized areas such as the Vaal Triangle which produces about 50% of the country's manufacturing output, is becoming a major issue. Although reuse of water in South Africa can, and probably will, be vastly increased, significant instances of such practice already exist. The following cases are briefly discussed; reclamation of sewage effluent for domestic recycling at Windhoek, South West Africa, based on successful pilot-scale investigations; use of biologically oxidized sewage effluent as cooling water in power generation; use of purified sewage effluent in pulp and paper manufacture; and the conservation of water by reuse within factories. Examples cited in the latter category include a beer brewery; an organic chemical industry in which the replanning of water management has, apart from a considerable saving in water consumption, resulted in the recovery of salable byproducts; and a major iron and steel industry where stringent water economy is practiced. Emphasis is placed on the key role of research in water resources exploitation. (Knapp-USGS)
W69-08031

CONSERVATION OF WATER BY REUSE IN THE UNITED KINGDOM,
Water Research Association, Medmenham (England); and Water Resource Board, Reading (England).
Derek G. Miller, and David H. Newsome.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 13-31, 1967. 19 p, 9 fig, 3 tab, 30 ref.

Descriptors: *Water reuse, *Reclaimed water, *Sewage treatment, Industrial wastes, Municipal wastes, Water utilization, Water temperature, Water loss, Water pollution, Costs, Water conservation.
Identifiers: *United Kingdom.

The historical background of water supply in the United Kingdom and the influence of recent legislation on water resources planning and effluent control are outlined. General consideration is given to available resources and the development of the pattern of demand. The principles of recycling are considered in relation to the overall effects and the impact on individual users. In particular the questions of effluent quality and disposal are discussed in the light of past practices. Some of the commonly used treatment methods are described and are shown to consist mainly of techniques to remove suspended solids and certain organic materials. Examples are given of recycling applications in the United Kingdom which have mainly arisen due to the shortage of water in certain areas. Finally, the paper attempts to assess the likely trends and possible limitations in the future use of recycling techniques. (Knapp-USGS)
W69-08032

CONSERVATION OF WATER BY REUSE IN ITALY,
Azienda Acquedotto Municipale di Torina (Italy).
Fulvio Meucci.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 32-36, 1967. 5 p, 5 fig, 1 tab, 11 ref.

Descriptors: *Water reuse, *Reclaimed water, Sewage treatment, Industrial wastes, Municipal wastes, Water utilization, Water temperature, Water pollution, Water conservation, Groundwater, Aquifers, Irrigation water, Water supply, Water resources development, Costs.
Identifiers: *Italy.

Water reuse in Italy is affected by underground availability and water rates. Three Italian reuse plants are described: In a sugar factory after simple sedimentation and sterilization, washing and conveying waters are recirculated; in a metal-working factory, acidic and alkaline waters are singly treated for removing cyanide and chromium and then mixed, neutralized, and clarified to be reused in a rain irrigation system and in fire protection; in a steel pipe mill, acid-washing waters and cooling waters, containing iron slags, are recirculated after oil removal, addition of hydrated lime, and clarification by ferrous sulfate, and cooling. (Knapp-USGS)
W69-08033

CONSERVATION OF WATER BY REUSE IN MEXICO,
Celulosa y Derivados, S.A., Monterrey (Mexico).
Carlos Griffith.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser 78, Vol 63, pp 37-40, 1967. 4 p, 8 tab.

Descriptors: *Water reuse, *Reclaimed water, *Sewage treatment, Water quality, Industrial wastes, Municipal wastes, Water utilization, Water conservation, Irrigation water, Water supply.
Identifiers: *Mexico.

Water is reclaimed for reuse in Mexico in 16 plants by the activated sludge process. Total capacity is 85.5 mgd. Most of the water is used for cooling, fire protection, and irrigation. Chemical analyses of water from each stage of treatment are tabulated. (Knapp-USGS)
W69-08034

WATER REUSE IN WEST GERMAN INDUSTRY,
Ruhrverband, Essen (West Germany).
Norbert Wolters.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 41-45, 1967. 5 p, 5 fig, 8 ref.

Descriptors: *Water reuse, *Reclaimed water, Industrial wastes, Municipal wastes, Water utilization, Costs, Taxes, Sewage treatment, Water resources development, Water pollution treatment.
Identifiers: *Germany, Ruhr Valley, Rhine Valley, Sewage taxes, Pollution taxes.

The great concentration of water-using industries in the Ruhr Valley, and the need to minimize pollution of the River Rhine, have forced maximum intraplant reuse of water. Special efforts are made in new plant design to make more effective reuse possible, resulting in the case of one steel mill completely reusing all incoming water. The creation of area water management associations that charge individual plants on the basis of pollution load of their effluents makes it worthwhile to continue studies for more efficient reuse. Special problems associated with beet sugar, coal mining, electroplating, and heavy chemicals industries are discussed.
W69-08035

THE UTILIZATION OF MUNICIPAL WASTEWATER IN JAPAN,
Ebara-Infilco Co., Tokyo (Japan).
Tetsuo Ide, Nobuo Matsumoto, and Hidenobu Arimitsu.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser 78, Vol 63, pp 46-53, 1967. 8 p, 14 fig, 3 tab, 16 ref.

Descriptors: *Water reuse, *Municipal wastes, *Industrial water, *Reclaimed water, Cooling water, Hardness (Water), Dissolved solids, Water quality, Sewage treatment, Water sources, Costs, Turbidity.
Identifiers: *Japan, Tokyo.

The rapid progress of Japanese industry has resulted in an increasing demand for water. Consequently, greater emphasis is beginning to be placed on water conservation. As a potential method for water conservation, some of the cities in Japan have built large industrial water plants utilizing sewage plant effluent as the water source, and have supplied a colloidal matter-free effluent to industries in the area. Suspended or colloidal matter is removed by coagulation with aluminum sulfate or ferric chloride, followed by sedimentation and filtration. Retardation on chemical softening caused by phosphate in sewage plant effluent can be overcome by the use of ferric chloride as a coagulant. (Knapp-USGS)
W69-08036

WATER REUSE IN ISRAEL,
Water Planning for Israel Ltd., Tel Aviv.
B. Caspi, Y. Zohar, and C. Saliternik.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 54-65, 1967. 12 p, 1 fig, 6 tab, 25 ref.

Descriptors: *Water reuse, *Reclaimed water, *Sewage treatment, Municipal wastes, Industrial wastes, Water utilization, Water storage, Artificial recharge, Irrigation water, Industrial water, Municipal water, Water conservation, Groundwater, Aquifers, Water resources development, Costs.
Identifiers: *Israel.

Water scarcity in Israel has resulted in reuse of 45,000 acre-ft/yr by 1965, and in planning for reuse of 110,000 acre-ft/yr by 1970, including reclamation for potable use by ponding, infiltration, and dilution of municipal wastewater: greater Tel Aviv, 80,000 acre-ft/yr; Jerusalem, 5,000 acre-ft/yr and of industrial wastewater: Hadera Paper Mills, 3,000 acre-ft/yr, and for unrestricted irrigation by biofiltration, complete disinfection, and dilution of Greater Haifa municipal wastewater (7,000 acre-ft/yr). Problems are salinity, disinfection, ion exchange brine, and nitrogen removal. Successes are development of highly-loaded ponds as a reliable treatment method, and planning for seasonal underground storage. (Knapp-USGS)
W69-08037

CONSIDERATIONS ON THE REUSE OF WATER IN CERTAIN INDUSTRIES,
Centre Belge d'Etude et de Documentation des Eaux (Liege).
E. H. T.H. Le Clerc.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 66-73, 1967. 8 p, 19 ref.

Descriptors: *Water reuse, *Sewage treatment, *Reclaimed water, *Recirculated water, Industrial wastes, Industrial water, Cooling water, Water utilization, Pulp and paper industry, Steel, Sugar beets, Coal mines.
Identifiers: Industrial water recirculation.

Water reuse in the coal mining, sugar, steel, and paper industries is discussed. In the steel industry, once-through use of 80-200 cu m of water per ton of steel may be reduced by recirculation to 2.5-4 cu m per ton. Treatment consists of cooling and removal of iron, cyanides, sulfur compounds, oxides, and suspended solids. Coal mines use 100-400 cu m of waste water per ton of coal. Suspended solids and phenols must be removed both for reuse and before final disposal. Sugar refineries can reuse most of their processing water, which is a serious source of pollution when it is discharged untreated. Processing of sugar requires 13-28 cu m per ton. Mud and organic materials must be removed for reuse and before discharge. Paper making uses about 100 cu m of water per ton of paper. The principal waste constituents to be removed are suspended inorganic and organic solids and dissolved organic matter. (Knapp-USGS)

W69-08038

CONSERVATION OF WATER BY REUSE IN THE UNITED STATES,
Celanese Corp. of America, New York.
Robert N. Rickles.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 74-87, 1967. 14 p, 12 fig, 13 tab, 95 ref.

Descriptors: *Water reuse, *Reclaimed water, *Industrial water, Governments, Research and development, Water pollution control, Water recirculation, Sewage treatment.
Identifiers: FWPCA, Office of Saline Water.

Water reuse in the chemical processing industries in the United States is discussed. Standards for water quality for cooling, boiler feed, petroleum refining, paper making, iron and steel making and food industry use are listed. Treatments for reuse include settling, filtration, flocculation, oxidation, aeration, activated sludge, distillation, freezing, hydration, deionization, cooling, activated carbon, membrane processes, and combinations of these methods. A bibliography of 95 papers on purification of industrial waters is given. The activities of the Office of Saline Waters and the Federal Water pollution Control Administration in promoting water purification research are briefly outlined. (Knapp-USGS)
W69-08039

WATER RECLAMATION,
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.; and Carnegie-Mellon Univ., Pittsburgh, Pa.
Henry C. Bramer, and Richard D. Hoak.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 92-95, 1967. 4 p, 7 ref.

Descriptors: *Water reuse, *Reclaimed water, *Water management (Applied), Recreation, Irrigation, Multiple-purpose projects, Artificial recharge, Industrial water, Sewage treatment, Cooling, Recirculated water.
Identifiers: Water reclamation, FWPCA.

Present-day water reclamation in the United States consists principally of the use of treated municipal wastewaters for recreation lakes, irrigation, groundwater recharge, and industrial purposes. The treatment usually consists of primary settling, secondary treatment by activated sludge or in oxidation ponds, and effluent chlorination. Although there are many instances of water reclamation being practiced in the United States today, the magnitude of the water use involved is small. Insofar as reclamation is a solution to problems of supply, the greatest potentials are in the arid western states, where an expanding economy and a westward moving population will increasingly press upon already limited supplies. Reclamation also, however, presents an attractive alternative to simple stream disposal of treated effluents, in many cases from an economic standpoint even with adequate freshwater supplies. Of particular significance in the future is the increased economic importance which recreational uses of the surface waters will have. (Knapp-USGS)
W69-08041

THE MEDICAL PROFESSION'S ATTITUDE TOWARD WATER REUSE,
American Medical Association, Chicago, Ill.
James G. Telfer.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 101-105, 1967. 5 p, 20 ref.

Descriptors: *Water Reuse, *Psychological aspects, Aesthetics, Attitudes, Decision making, Environmental engineering, Sewage treatment, Recirculated water, Municipal water.
Identifiers: Medical profession attitudes.

Physicians, a heterogeneous group, are vitally concerned with life and environment, and especially with water and its uses. They think of many cycles of water, in the body and in the environment. There are many kinds or reuse--of many kinds of water. Direct reuse in community drinking systems is a part of total environmental management. Medical societies are a good means of determining the medical profession's attitude and ought to be included in all phases of such reuse programs. The physician's attitude to reuse of treated sewage effluent is likely to be favorable when need is demonstrated. Medical societies should be consulted for help and criticism in any public water reclamation projects if the water is to be used for human consumption. (Knapp-USGS)
W69-08042

THE ROLE OF CHEMICALS IN WATER REUSE,
Aquacontrol, Inc., Houston, Tex.
M. C. Forbes, and P. A. Witt, Jr.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 124-129, 1967. 6 p, 5 fig, 4 ref.

Descriptors: *Water reuse, *Sewage treatment, *Reclaimed water, *Recirculated water, *Water chemistry, Municipal wastes, Industrial wastes, Tertiary treatment, Water purification, Potable water, Pollution control, Costs, Water costs, Water quality control.
Identifiers: Waste treatment chemicals.

Pollution is expanding exponentially and grows as the second power of population. These 2 facts make the adoption of the zero effluent plant an absolute necessity sooner than we had expected. Purification processes are pollutional processes. The entropy analogy of pollution processes indicates that the role of chemicals will become a continuously declining one. The shift in economics will, on the other hand, dictate that chemical engineers a managers and technologists will become more and more involved in waste prevention. The success of the individuals, and the plants with which they are associated, will be closely related to their skills in this area. Regulation will change sharply, and will be supported by public demand based on the all too obvious effects of increasing population density. These facts will be a tremendous threat and source of loss to some, and a real opportunity for competitive advantage for those who can sense these changes and adapt in time. (Knapp-USGS)
W69-08045

VIRUS REMOVAL IN WATER REUSE TREATING PROCESSES,
Maine Univ., Orono.
Otis J. Sproul, Leo R. Larochelle, David R. Wentworth, and Robert T. Thorup.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 130-136, 1967. 7 p, 2 fig, 6 tab, 24 ref.

Descriptors: *Water reuse, *Viruses, *Water purification, Filtration, Adsorption, Activated carbon, Biological treatment, Disinfection, Public health, Water treatment.
Identifiers: Virus removal.

The literature is reviewed for virus removal by primary and secondary treatment processes. The activated sludge process has been reported to yield removals of viruses in excess of 90%. Chlorination, as presently practiced, results in removals of only 90 to 99%. The adsorption of T2 bacteriophage on activated carbon from a secondary effluent was reversible and never exceeded 35% at low flow rates. Removals of Type 1 polio virus in excess of 90% were obtained in the lime precipitation of phosphate. (Knapp-USGS)
W69-08046

IONIZING RADIATION IN WATER REUSE,
Unidynamics/Phoenix, Ariz.
Hal R. Spragg, and Richard L. Curtin.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 137-142, 1967. 6 p, 3 fig, 19 ref.

Descriptors: *Water reuse, *Water treatment, *Water purification, Ionization, *Radioactivity techniques, Oxidation, Sewage treatment, Chemical degradation, Tertiary treatment, Organic matter.
Identifiers: Ionizing radiation, Radiolysis, Gamma radiation.

The use of gamma radiation as a unit process has become firmly established in the past decade and is of significant potential value in amerliorating some of the present problems associated with the treatment of wastewater for reuse. Recent studies of the effects of radiation on domestic sewage showed that the sedimentation of suspended solids is significantly accelerated and that the radiolysis of dilute, aqueous systems of various contaminants results in products which are either less refractive to removal by conventional means or not objectionable as constituents of effluent water. The radio-oxidation of ammonia is analyzed as a model system. The costs of radiation have moderated significantly over the past few years. The principal expenditures required are for the treatment facility itself and for the radioactive material. Expenses for personnel training and facility maintenance are moderate to nominal. (Knapp-USGS)
W69-08047

PHOSPHATE REMOVAL BY ACTIVATED SLUDGE AT SAN ANTONIO, TEXAS,
Municipal Waste Water Treatment Plants, San Antonio, Tex.; and Texas Univ., Galveston. Medical Branch.
Don Vacker, C. H. Connell, and W. N. Wells.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 148-158, 1967. 11 p, 9 fig, 11 tab, 13 ref.

Descriptors: *Sewage treatment, *Phosphates, *Activated sludge, *Adsorption, *Texas, Biodegradation, Biochemical oxygen demand.
Identifiers: Phosphate removal.

Phosphates are removed in municipal wastewater treatment plants in the aeration tanks by sorption to the activated sludge solids under proper operational conditions. Removal is necessary to prevent algae growths in streams receiving plant effluent. Dissolved oxygen, biochemical oxygen demand to activated sludge loading, mixed liquor suspended solids, ammonia, nitrate, and sludge volume index was studied. Effects of dissolved oxygen, desorption, variation in daily load, and phosphate in waste activated sludge were also studied. Effect of operational differences of three parallel plants are noted. Nonreturn of waste activated sludge degradation products is essential unless chemically treated. Future design and operation considerations are proposed. (Knapp-USGS)
W69-08048

PROBLEMS AND PRACTICE OF PHOSPHATE REMOVAL IN WATER REUSE,
Lawrence K. Cecil.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 159-163, 1967. 5 p, 22 ref.

Descriptors: *Water reuse, *Sewage treatment, *Phosphates, Activated sludge, Adsorption, Biodegradation, Chemical precipitation, Waste water disposal.
Identifiers: *Phosphate removal.

The literature on phosphate removal for waste water reuse is reviewed. The operation of full-scale plants is compared with theory. Pilot plant studies show that phosphate can be removed effectively by adsorption on sludge, and that sludge may be treated to recover process reagents. (Knapp-USGS)
W69-08049

WATER RECLAMATION WITH GRANULAR ACTIVATED CARBON,
Pittsburgh Activated Carbon Co., Pa.; and Calgon Corp., Pittsburgh.
J. C. Cooper, and D. G. Hager.

Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 185-192, 1967. 8 p, 5 fig, 8 tab, 10 ref.

Descriptors: *Water reuse, *Water costs, *Desalination, *Sewage treatment, Costs, Optimization, Decision making, Cost-benefit analysis, Activated carbon, Tertiary treatment.
Identifiers: Desalination costs, Water reclamation costs.

The costs and efficiency of water reclamation by activated carbon are summarized and processing design parameters are tabulated for optimizing engineering decisions in reuse. The present state of activated carbon system development suggests that the process is immediately applicable to many municipal and industrial wastes for pollution abatement or for water reclamation. Municipal waste water reclamation could produce potable water at 16 cents per 1,000 gal at an investment of $33 million. This may be compared to the recent proposal to build a sea-water desalination plant in Southern California to supply 150 mgd at 23-30 cents per 1,000 gal at an investment of $300 million. (Knapp-USGS)
W69-08050

SUCCESSES AND FAILURES IN WATER REUSE,
Cosden Oil and Chemical Co., Big Spring, Tex.
Warden W. Mayes, and William E. Gibson.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 197-200, 1967. 4 p, 2 fig, 1 tab, 3 ref.

Descriptors: *Water reuse, *Municipal wastes, *Reclaimed water, *Decision making, Oil industry, Cooling water, Costs, Water costs, Water quality, Water treatment, Sewage treatment.
Identifiers: Water reuse costs.

An oil refinery's experience with using reclaimed municipal waste water for 15 years is discussed and economic data are presented to aid in making decisions in the choice between using sewage effluents and other sources of poor-quality water. Foaming, corrosion, and excessive gypsum content of the water were the only major problems encountered. (Knapp-USGS)
W69-08051

HISTORY AND POSSIBLE FUTURE OF MULTIPLE REUSE OF SEWAGE EFFLUENT AT THE ODESSA, TEXAS INDUSTRIAL COMPLEX.
Aetron, Covina, Calif.; and El Paso Products Co., Odessa, Tex.
F. W. Kirkpatrick, Jr., and E. F. Smythe.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 201, 209, 1967. 9 p, 3 fig, 1 tab, 2 ref.

Descriptors: *Water reuse, *Reclaimed water, Municipal wastes, *Recirculated water, *Oil industry, *Texas, Sewage treatment, Desalination, Water sources, Water management (Applied), Industrial water, Cooling water, Ion exchange, Water storage.
Identifiers: Odessa (Tex).

Present treatment to produce makeup to boilers and cooling towers from sewage effluent is shown by schematic flow diagram, and performance is indicated by water analyses. Operating experience with problems relating to sewage effluent storage, ion exchange resin beds, and calcium carbonate precipitation after lime treatment are discussed. Wastewater treatment and disposal by further use in oil field water flood operations is described. Examples of present reuse and some further potential reuses developed during a study by Aetron are presented. A possible future sewage treatment system and a system to maximize reuse by using a desalting process as suggested by the Aetron study are described. (Knapp-USGS)
W69-08052

REMOVAL OF NITROGENOUS COMPOUNDS FROM WASTEWATERS,
Carnegie-Mellon Univ., Pittsburgh, Pa.
William R. Samples.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 223-229, 1967. 7 p, 1 fig, 35 ref.

Descriptors: *Waste water treatment, *Water reuse, *Nitrogen, Nitrogen compounds, Oxidation, Biodegradation, Nitrification, Denitrification, Nutrients, Tertiary treatment, Algae, Ammonia.
Identifiers: Nitrogen removal.

Normal treatment of our waterborne wastes has not in the past been concerned with removal of nitrogenous materials. In recent years, however, waste discharges containing compounds of nitrogen have been incriminated in the fertilization of streams and lakes, causing possible health hazards, and in general, causing a decrease in water quality for many uses. A review of many investigations into mechanisms for removal of nitrogenous materials in waste effluents is given. The mechanisms reviewed include both biological and chemical methods. Nitrogenous materials may be removed from waste effluents by any one of several methods. The most applicable at the present time appear to be denitrification, incorporation by algae, and ammonia stripping. The selection of the proper method for nitrogen removal in any particular case will depend on the local circumstances, including other treatments required, degree of nitrogen removal desired, chemical quality of the water, further uses for the water, and many others. The removal of nitrogen from effluents will be expensive but will by justifiable in an increasing number of instances. (Knapp-USGS)
W69-08053

A DESIGN PROCEDURE FOR BIOLOGICAL NITRIFICATION AND DENITRIFICATION,
Texas Univ., Austin.
W. Wesley Eckenfelder, Jr.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 230-234, 1967. 5 p, 6 fig, 1 tab, 6 ref, append.

Descriptors: *Denitrification, *Biodegradation, *Water reuse, *Reclaimed water, Nitrogen compounds, Nitrogen, Ammonia, Nutrients, Biochemical oxygen demand, Tertiary treatment, Algae, Bacteria, Activated sludge.
Identifiers: Nitrogen removal.

The removal of nitrogen from sewage and industrial wastewaters is assuming increasing importance as the waste loadings from urban and industrialized areas increase. Unoxidized nitrogen exerts on oxygen demand on the receiving waters and oxidized nitrogen serves as a nutrient source for algal growth. It is possible to remove nitrogen by biological means by first oxidizing ammonia to nitrates followed by denitrification in which microorganisms reduce the nitrate to nitrogen gas. Studies which have been conducted on this process to date in laboratory, pilot-plant, and, to a limited extent, plant-scale investigations are reviewed. The theory of the process operation is developed from basic microbiological considerations. A design example for a sewage treatment plant is presented to illustrate the development of the process. (Knapp-USGS)
W69-08054

PROGRESS IN CONTROLLING ACID MINE WATER: A LITERATURE REVIEW,
Bureau of Mines, Pittsburgh, Pa. Coal Mining Research Center.
For primary bibliographic entry see Field 05G.
W69-08059

5E. Ultimate Disposal of Wastes

METHODS FOR THE STUDY OF HYDROGEOLOGICAL PARAMETERS OF UNDERGROUND STORAGE OF INDUSTRIAL WATER DISCHARGES (RUSSIAN),
Moscow State Univ. (USSR).
V. M. Goldberg, S. M. Semenova, Ye. G. Chapovskiy, and V. M. Shestakov.
Razved i Okhrana, No 3, pp 41-46, Mar 1969. 6 p, 2 tab.

Descriptors: *Hydrogeology, *Water pollution, *Underground storage, *Sewage disposal, Water reuse, Cost analysis, Industrial waste, Water analysis, Water purification, Pumping, Boreholes, Exploitation, Chemical analysis, Temperature, Permeability.
Identifiers: *Underground water storage.

After tracing briefly the development of underground storage techniques of polluted waters in USSR and abroad (USA, France, etc.), the authors discuss the field and laboratory analyses of pertinent characteristics of reservoir rocks and industrial waters whose preliminary knowledge is necessary for efficient storage of polluted waters. The main characteristics of the analysis are the forecasting of pollution circulation and the extent and permeability of the layers under study. The study shows that the utilization of natural earth crust structures for storage of polluted waters necessitates the following preliminary steps: (1) development of the methods capable of recognizing the presence of homogeneity characteristics in water-bearing formations, also the polluted water circulation patterns; (2) the study of hydrodynamics of interacting horizons; (3) development of analytical basis for the quantitative evaluation of physico-chemical interaction taking place between the pumped liquid and liquid content of rock formations; and (4) development of better technology in using boreholes in exploration and exploitation. (Gabriel-USGS)
W69-08015

PROPOSED DELAWARE VALLEY INDUSTRIAL WASTELINE - LEGAL IMPLICATIONS,
Franklin Inst. Research Labs., Philadelphia, Pa. Inst. for the Development of Riverine and Estuarine Systems.
For primary bibliographic entry see Field 05G.
W69-08119

5F. Water Treatment and Quality Alteration

CONSERVATION OF WATER BY REUSE IN THE UNITED KINGDOM,
Water Research Association, Medmenham (England); and Water Resource Board, Reading (England).
For primary bibliographic entry see Field 05D.
W69-08032

WATER REUSE IN ISRAEL,
Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 05D.
W69-08037

THE MEDICAL PROFESSION'S ATTITUDE TOWARD WATER REUSE,
American Medical Association, Chicago, Ill.
For primary bibliographic entry see Field 05D.
W69-08042

VIRUS REMOVAL IN WATER REUSE TREATING PROCESSES,
Maine Univ., Orono.
For primary bibliographic entry see Field 05D.
W69-08046

PERCEPTION AND PUBLIC POLICY IN THE RECREATIONAL USE OF DOMESTIC WATER SUPPLY RESERVOIRS,
Southern Illinois Univ., Carbondale.
For primary bibliographic entry see Field 06B.

W69-08060

5G. Water Quality Control

REDUCTION OF RIVER HEAT POLLUTION BY TURBULENCE STIMULATION,
Sacramento State Coll., Calif. Dept. of Civil Engineering; and Connecticut Univ., Storrs. Dept of Civil Engineering.
For primary bibliographic entry see Field 05B.
W69-07702

CHEMICAL EQUILIBRIA AND ZONING OF SUBSURFACE WATER FROM JACHYMOV ORE DEPOSIT, CZECHOSLOVAKIA,
Geological Survey of Czechoslovakia, Prague.
Tomas Paces.
Geochim et Cosmochim Acta, Vol 33, No 5, pp 591-609, May 1969. 19 p, 6 fig, 6 tab, 23 ref.

Descriptors: *Water chemistry, *Mine water, Chemical potential, Aqueous solutions, Ions, Solutes, Equilibrium, Mineralogy. Sulfides, Oxidation-reduction potential.
Identifiers: Czechoslovakia.

Water samples from the surface and from various underground levels of the Svornost mine, Jachymov, Czechoslovakia were analyzed. Eh and pH were measured in the field. The saturation indices of water and carbon dioxide in the atmosphere, the water-calcite system, the water-iron hydroxide system, and the water-pyrite system are given. Individual redox zones in the water body are consistent with zones of secondary sulfide ore deposition. Complexing of major ions, mineral space-relations, and temperature relations were considered in the calculations. (Knapp-USGS)
W69-07703

OCCURRENCE AND SIGNIFICANCE OF PESTICIDE RESIDUES IN WATER,
Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab.
H. Page Nicholson.
J Wash Acad Sci, Vol 59, No 4-5, pp 77-85, Apr-May 1969. 9 p, 1 tab, 29 ref.

Descriptors: *Water pollution sources, *Water pollution effects, *Pesticide residues, Fishkill, Pesticide kinetics, Water pollution control, Runoff, DDT, Dieldrin, Endrin, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides.
Identifiers: Pesticide pollution.

Water pollution by insecticides has been a problem since the 1940's. Many of the synthetic pesticides are very lethal to aquatic life, and fishkills and loss of the aquatic insects eaten by fish are common occurrences. Sublethal concentrations of insecticides cause high residual concentrations in fish; when the fish are eaten by birds, damage to the birds is a frequent result. An agricultural watershed with 13,000 to 16,000 acres of cotton treated with 12,000 to 14,000 lbs of toxaphene, DDT, and BHC was sampled. Insecticide concentrations were generally less than 1 microgram per liter in the river water, and insecticides were detected all year, not just during the application season. DDT was seldom recovered from water because it was usually associated with stream sediment. Pesticide waste discharges, accidents, and carelessness often contaminate surface waters. Pesticide pollution control depends on prevention of spills into waters and upon user control of agricultural application to prevent contamination of runoff. The use of the slowly degrading chlorinated hydrocarbons should be restricted and carefully regulated. (Knapp-USGS).
W69-07704

A SURVEY OF HEAT SINK CAPACITY OF MAJOR STREAMS WITHIN THE U. S.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W69-07720

WATER AND METROPOLITAN MAN,
American Society of Civil Engineers, Cambridge, Mass. Urban Hydrology Research Council.
For primary bibliographic entry see Field 06B.
W69-07722

A RECONNAISSANCE STUDY OF THE CHESAPEAKE BAY,
Regional Planning Council, Baltimore, Md.
Paul R. Farragut.
Reg Planning Counc, Baltimore, Md, Sept 1868. 90 p, 6 fig, 32 map, 25 ref, 2 append. Available from Clearinhouse as Pb 182 120 at $3.00 in paper copy and $0.65 in microfiche.

Descriptors: *Estuaries, *Maryland, *Water resources, *Water quality control, Water quality act, Standards, Governments, Regulation, Water pollution, Erosion, Eutrophication, Wetlands, Tides, Floods.
Identifiers: Chesapeake Bay (Md).

The problems of the Chesapeake Bay shoreline and of the waters of the bay are discussed. The physical problems discussed are erosion, sedimentation, flooding, eutrophication, polluted shellfish areas, thermal pollution, plant and animal nuisances, and the use of and damage to wetlands. Stream water quality is discussed with reference to Maryland's water quality standards. Agencies involved in water resources, hunting, fishing, and recreation are listed and their areas of responsibility are discussed. (Knapp-USGS)
W69-07742

DEVELOPMENT IN THE POOR NATIONS: HOW TO AVOID FOULING THE NEST,
For primary bibliographic entry see Field 06G.
W69-07773

EVALUATION OF THE PYRIDINE-ALKALI COLORIMETRIC METHOD FOR DETERMINATION OF ATRAZINE,
Wisconsin Univ., Madison. Dept. of Soils.
For primary bibliographic entry see Field 05A.
W69-07821

EFFECTS OF GAMMA RADIATION ON ACCUMULATION OF MINERAL NITROGEN IN FRESH SOILS,
United Kingdom Atomic Energy Authority, Wantage (England). Research Group.
P. A. Cawse.
J Sci Food Agric, Vol 19, pp 395-398, July 1968. 3 fig, 1 tab, 17 ref.

Descriptors: *Irradiation, *Gamma rays, *Nitrogen, *Soils, Sediments, Nitrogen compounds, Nitrification, Nitrogen cycle, Bacteria, Soil bacteria, Organic soils, Cycling nutrients, Radioecology.
Identifiers: Ammonium ions, Mineral nitrogen, Nitrifying bacteria.

Gamma-irradiated soils that had received 0.05 to 3 Mrad showed a significant increase in extractable nitrate-nitrogen. The response was greatest for the most organic soil. Perfusion of the soil with ammonium ions showed that rapid nitrification occurred after doses greater than 0.1 Mrad. This increase resulted from oxidation by non-proliferating cells of the nitrifying bacteria rather than from increased proliferation of the survivors. (Konrad-Wisc)
W69-07825

SOIL DEGRADATION OF DIAZINON, A PHOSPHOROTHIOATE INSECTICIDE,
Wisconsin Univ., Madison. Dept. of Soils.
For primary bibliographic entry see Field 05B.
W69-07867

LIMITATION OF NUTRIENTS AS A STEP IN ECOLOGICAL CONTROL,
Wisconsin Univ., Madison. Hydraulic Lab.; and Wisconsin Univ., Madison. Sanitary Lab.
For primary bibliographic entry see Field 05C.
W69-07869

STORAGE OF NATURAL OR ARTIFICIAL GAS AND PETROLEUM PRODUCTS IN PRINCE GEORGE'S COUNTY.
For primary bibliographic entry see Field 06E.
W69-07906

PESTICIDE RESIDUES IN SEDIMENTS OF THE LOWER MISSISSIPPI RIVER AND ITS TRIBUTARIES,
National Communicable Disease, Atlanta, Ga.; Food and Drug Administration, Washington, D. C.; Agricultural Research Service, Oxford, Miss. Sedimentation Lab.; and Agricultural Research Service, Gulfport, Miss. Plant Pest Control Div.
For primary bibliographic entry see Field 05B.
W69-07921

A SYSTEMS ENGINEERING APPROACH TO WATER QUALITY MANAGEMENT,
Kaiser Engineers, Oakland, Calif.
E. J. Stann, and R. J. Ringwood.
Civil Eng, Vol 39, No 6, pp 74-79, June 1969. 6 p, 4 fig.

Descriptors: *Planning, *Water pollution control, *Water resources development, *California, *Systems analysis, Estuaries, Model studies, Mathematical models, Optimization, Water management (Applied), Regional analysis, Water reuse, Tertiary treatment.
Identifiers: *San Francisco Bay area, Systems engineering.

The San Francisco Bay area has enough water, but much will be exported, thus reducing its waste-dilution capacity. An increasing amount of agricultural drainage is worsening the problem. A proposed region-wide solution, includes quality and effectiveness, cost feasibility, geo-economic influences, and social and esthetic requirements. Two new parameters of waste disposal and waste effects--toxicity and biostimulation--were employed. Three mathematical models of the area and system were used: a tidal hydrodynamic model, a dynamic water quality model, and a dispersion water quality model. Treatment and disposal facilities, should be constructed in 3 phases: Phase 1, 1970-1980, to convey effluents from problem areas where there is little waste dilution, toward the central Bay. Phase 2, 1980-1990, features a major ocean outfall and diffuser system, with wastes sent to the ocean getting advanced primary treatment, Phase 3, 1990-2020, essentially a planning guide, calls for regional reclamation of municipal wastewaters. The regional system is preferred over the present local-treat ment arrangement. The regional system is somewhat less costly. The study showed that the system engineering approach is essential in preparing a regional water management plan. (Knapp-USGS)
W69-07924

NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS, WATER YEAR 1969.
Geological Survey, Washington, D. C.

Geol Surv Nat Ref List of Water Quality Sta, 1969. 693 p, 7 tab, index.

Descriptors: *Gaging stations, *Water quality, *Sampling, *United States, Data collections, Hydrologic data, Stream gages, Water year, Streamflow.
Identifiers: *Water quality stations.

Water quality stations operating in the U.S. in 1969 are listed. For each station, an identification number, latitude, longitude, station name, drainage

area, state, county, date of initiation, type, discharge, type of record, and frequency of sampling are listed. Stations are summarized by state and territory, and sources of operating funds are listed. (Knapp-USGS)
W69-07941

ANIMAL WASTES--A NATIONAL PROBLEM,
Cornell Univ., Ithaca, N. Y. Dept. of Agriculture; and Cornell Univ., Ithaca, N. Y. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W69-08010

OIL SPILLAGE PREVENTION, CONTROL, AND RESTORATION-STATE OF THE ART AND RESEARCH NEEDS,
Battelle Memorial Inst., Richland, Wash.; and Hydronautics, Inc., Laurel, Md.
W. H. Swift, C. J. Touhill, W. L. Templeton, and D. P. Roseman.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, pp 392-412, Mar 1969. 21 p, 1 fig. Contract No TCG-15560-A (DOT-Coast Guard).

Descriptors: *Oily water, *Water pollution sources, *Ships, *Oil wastes, *Water pollution treatment, Water pollution control, Disasters, Industrial wastes, Shores, Aquatic life.
Identifiers: *Oil spill prevention and cleanup.

A review was made to evaluate the current state of technology of prevention and control of major oil spillage on water, the restoration of the shore face and waterfowl, and the effects of oil pollution and defensive measures on aquatic life. The study was made to assist in establishing procedures and facilities for standardized control and cleanup based on current technology and experience, and to show that additional research and development could result in improved capability for prevention, control, and restoration. Detailed research and development recommendations for prevention, control, and restoration are made. A plan of action which improves the capability for preventing and combating oil spillage and for minimizing its consequences is proposed. (Knapp-USGS)
W69-08014

CHLORINATED INSECTICIDES IN RUNOFF WATER AS AFFECTED BY CROP ROTATION,
Agricultural Research Service, Orono, Maine. Dept. of Plant and Soil Science; and Maine Univ., Orono. Water Resources Center.
For primary bibliographic entry see Field 05B.
W69-08028

WASTES IN RELATION TO AGRICULTURE AND FORESTRY,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 05C.
W69-08029

WATER RESOURCES AND THE LEGISLATIVE BRANCH,
Subcommittee on Air and Water Pollution (U. S. Congress).
Donald E. Nicoll.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 88-91, 1967. 4 p.

Descriptors: *Water pollution control, *Water Quality Act, *Legislation, Water quality control, Waste treatment, Governments, Research and development, River basin development, Planning, Water resources development, Water law.
Identifiers: *Water Pollution Control Act, FWPCA.

Environmental contamination threatens to reduce available water supplies below demands. The Water Quality Act of 1965 upgraded the water pollution control program administration and established a water quality standards system for water resource planning, management, and improvement. The 1966 Water Pollution Control Act amendments increased Federal sewage treatment construction grants and increased grants for research and development of improved methods for industrial and municipal waste treatment. Next steps involve river basin planning and development, simplification of Federal grant programs, new control techniques, and better understanding of long-term pollution threats. (Knapp-USGS)
W69-08040

LEGAL ASPECTS OF WATER REUSE IN TEXAS,
Vinson, Elkins, Weems and Searls, Houston, Tex.
Victor W. Bouldin.
Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 110-113, 1967. 4 p.

Descriptors: *Water law, *Texas, *Water reuse, Reclaimed water, Recirculated water, Legal aspects, Prior appropriation, Water transfer, Water management (Applied), Water rights, Water policy, Sewage treatment.
Identifiers: Texas Water Law.

The basic water laws in Texas are discussed, as well as the possibilities and liabilities in transfer of ownership of wastewater for subsequent reuse. Texas uses the system of prior appropriation rights to water. Depending on the water permit, water may be reused by the appropriator or may be sold for others' reuse. Each permit specifies the use the appropriator may make of the water and what portion of it must be returned. Limitations of rights include source, purpose, amount, point of diversion, point of return, description of land irrigated, and interbasin transfers. Contracts for reuse should specify rights, duties, obligations, and liabilities of all parties, the amount of water to be delivered, rates of delivery, periods of delivery, temperature, method of delivery, pressure, price, and disposition after reuse. (Knapp-USGS)
W69-08043

PROGRESS IN CONTROLLING ACID MINE WATER: A LITERATURE REVIEW,
Bureau of Mines, Pittsburgh, Pa. Coal Mining Research Center.
Walter C. Lorenz.
Bur Mines Inform Circ No 8080, 1962. 40 p, 11 fig, 2 tab, 207 ref.

Descriptors: *Acid mine water, *Water pollution control, *Reviews, Water pollution sources, Bibliographies, Sulfates, Acid bacteria, Mine drainage.
Identifiers: Acid mine drainage control.

Literature on the control of acid mine drainage published before 1962 is reviewed. A bibliography of 207 entries is included. The topics reviewed are sources of pollution, neutralization of acid mine water, mine sealing, inhibition of acid formation, and drainage control. (Knapp-USGS)
W69-08059

OPTIMIZATION OF A CLASS OF RIVER AERATION PROBLEMS BY THE USE OF MULTIVARIABLE DISTRIBUTED PARAMETER CONTROL THEORY,
Western Electric Co., Inc., Princeton, N. J. Engineering Research Center; Newark Coll. of Engineering, N. J.; and Rutgers - The State Univ., New Brunswick, N. J.
Victor J. Tarassov, Harlan J. Perlis, and Burton Davidson.
Water Resources Research, Vol 5, No 3, pp 563-573, June 1969. 11 p, 9 fig, 2 tab, 19 ref.

Descriptors: *Aeration, *Water pollution, Linear programming, Dynamic programming, Costs.
Identifiers: *Control theory, Pontryagin's Maximum Principle, Streeter-Phelps system equations, Objective function, Optimal control, Multivariable system.

Mathematical programming methods applied to water pollution problems have been highly successful, especially in cases where hypothetical models were used. In many applications, linear programming, dynamic programming, or Pontryagin's Maximum Principle methods have been demonstrated using steady state Streeter-Phelps system equations at some stage in the optimization study. The authors propose to examine the application of the Sirazetdinov-Tarassov-Perlis theory of optimal control to the artificial in-stream aeration problem in polluted rivers. The main concern of the study is to show how artificial in-stream aeration can be controlled so as to minimize the relative cost of operation for several competing design criteria. The economic aspects of cost minimization of this process has important theoretical implications and potential applications to specific water pollution problems. (Loeb-Rutgers)
W69-08061

STREAMS, RIVERS AND LAKES: POLLUTION PROBLEMS,
Syracuse Univ., N. Y.
Nelson L. Nemerow.
The Rresh Water of New York State: Its Conservation and Use, pp 30-33, Wm C Brown Book Co, Dubuque, Iowa, 1967. 4 p, 1 disc. Edited by Lauren B. Hitchcock.

Descriptors: *Streams, *Rivers, *Lakes, *Water pollution, River basins, Wastes, Water quality, Organic matter, Salts, COLOR, Turbidity, Heat, Oil, Bacteria, Protozoa, Viruses, Acids, Alkalis, Prices, Water allocation, Odor.
Identifiers: Economic worth, Toxic matter, Suspended solids, Radioactive matter, Grease, Surface, Active matter, Odoriferous matter.

A state of stream pollution is defined to exist when excessive contamination interferes with the use of water as a resource. Fourteen typical examples of contaminants are given. Contemporary problems are described for each of these contaminants. The writer attempts to relate the past and present emphasis is on stream pollution to the future situations which we face. The writer believes that a system of equitable allocation of stream pollution capacity will be vital to future pollution abatement programs. The system should be based upon the economic worth of the resource as well as the subjective desires of the local river basin community. Several challenging technical problems are also presented. (See W69-08076). (Loeb-Rutgers)
W69-08078

ECONOMY OF WATER QUALITY MANAGEMENT AND POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.
James J. Plannery.
The Fresh Water of New York State: Its Conservation and Use, pp 51-57, Wm C Brown Book Co, Dubuque, Iowa, 1967. 7 p. Edited by Lauren B. Hitchcock.

Descriptors: *Water quality, *Energy, *Conservation, *Water pollution control, *Waste disposal, Fishing recreation, Water treatment, Costs, Benefits.
Identifiers: *Water quality management, Public water, Least-cost alternatives.

This paper describes the dimensions of the water pollution problem; indicating the sources, the kinds, the effects, and the magnitudes of pollution, so far as they are known. The economic aspects of pollution are based on the conflicts between waste disposal and other uses of the public waters. The greatest conflict is with the uses that take place in the public waters themselves -- fishing, recreation, and aesthetics. The withdrawal uses are also effected but those effects may be corrected by water treatment. An optimum arrangement among uses, including waste disposal, can be determined by analyzing incremental costs and benefits or by calculating the benefit and cost variations among different least-cost alternatives. Furthermore, the

paper says that requiring waste disposers to pay in proportion to their use of the public waters for disposal probably would facilitate the optimization process considerably, for it would cause the waste disposers to be cost-conscious to the extent that they would reduce wastes to save money. Intensive study of the idea is urged. (See W69-08076). (Loeb-Rutgers)
W69-08079

PROPOSED DELAWARE VALLEY INDUSTRIAL WASTELINE - LEGAL IMPLICATIONS,
Franklin Inst. Research Labs., Philadelphia, Pa. Inst. for the Development of Riverine and Estuarine Systems.
Earl F. Murphy, and Ruth L. Kovnat.
IDRES Information Center Report No 1, April 1969. 30 p, 48 ref. Pa. 29-Grant GA-4468 F P.

Descriptors: *Legal aspects, *Waste water disposal, *Pipelines, Industrial wastes, Jurisdiction, Law of the sea, Continental Shelf.
Identifiers: Ocean disposal.

International, federal, and state (Pennsylvania, New Jersey, and Delaware) laws that might have a bearing on the establishment and operation of the Delaware Valley Industrial Wasteline were reviewed to identify any areas of potential legal conflict affecting its institution so that appropriate steps could be taken to forestall these conflicts. Because the proposed wasteline will collect concentrated effluents from industries along the Delaware River from Trenton to just south of Philadelphia and transport them through a pumped pipeline across southern New Jersey for disposal beyond the Continental Shelf break, there is no way that this wasteline can avoid scrutiny by the Delaware River Basin Commission, the Department of the Interior, and the Department of State, insofar as other nation-states might object to the wasteline's outfall in the ocean. Three types of organization were studied to determine which would be the best form for the implementation of the wasteline from a legal and political point-of-view: (1) a public utility; (2) an interstate authority (a public authority); and (3) a Federal authority, that is, one similar to the Tennessee Valley Authority. On the basis of the analysis of existing statutes and with the hope of coordinating as many of the interested parties as possible, the public authority form of organization is recommended. It is concluded that if the Delaware Valley Industrial Wasteline is shown to be technically feasible and if it is demonstrated that this kind of pipeline can ameliorate the pollution problems of inland waters without adversely affecting the oceans, legal barriers to its institution are surmountable. The report contains a bibliography of 48 references, most of which are annotated. (Devlin-Franklin Institute)
W69-08119

SOME DATA ON DIFFUSION AND TURBULENCE IN RELATION TO REAERATION,
Illinois Univ., Urbana. Water Resources Center.
E. R. Holley.
Research Report No 21, Water Resources Center, University of Illinois July, 1969, iii+ 53 pp, 13 fig, 26 ref. OWRR Project A-021-ILL.

Descriptors: *Reaeration, *Dissolved oxygen, Diffusion, Turbulence.

Heat was used as a tracer to determine diffusion rates immediately below the free surface both in the 'film' region and in the remainder of the water in a mixing vessel. The results tend to indicate that a diffusion model can be used to represent the downward transport of a substance which is being absorbed at the free surface. Apparently, the diffusion coefficient in the 'film' can be either equal to or greater than the molecular coefficient depending on the amount of mixing at the free surface. Hot film anemometry was used to determine turbulence characteristics from 1 in. to 0.006 in. below the free surface of a laboratory open channel flow. The energy spectra indicate no significant changes in the turbulence in this region. Thus, apparently turbulence exists to the free surface and in the 'film' region.
W69-08126

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

COMPUTER AIDED DESIGN OF WASTE WATER COLLECTION AND TREATMENT SYSTEMS,
Michigan Univ., Ann Arbor. Dept. of Environmental Health.
For primary bibliographic entry see Field 05D.
W69-07714

A TEST SIMULATION OF POTENTIAL EFFECTS OF THERMAL POWER PLANTS ON STREAMS IN THE UPPER MISSISSIPPI RIVER BASIN,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W69-07738

PERT SIMULATION: A DYNAMIC APPROACH TO THE PERT TECHNIQUE,
Oregon State Univ., Corvallis; and Foamat Foods Corp., Corvallis, Oreg.
For primary bibliographic entry see Field 07C.
W69-07775

THE CONCEPTUAL FORMULATION AND MATHEMATICAL SOLUTION OF PRACTICAL PROBLEMS IN POPULATION INPUT-OUTPUT DYNAMICS,
Department of Agriculture, Ottawa (Canada). Statistical Research Services.
For primary bibliographic entry see Field 06G.
W69-07816

A SYSTEMS ENGINEERING APPROACH TO WATER QUALITY MANAGEMENT,
Kaiser Engineers, Oakland, Calif.
For primary bibliographic entry see Field 05G.
W69-07924

OPTIMIZATION OF A CLASS OF RIVER AERATION PROBLEMS BY THE USE OF MULTIVARIABLE DISTRIBUTED PARAMETER CONTROL THEORY,
Western Electric Co., Inc., Princeton, N. J. Engineering Research Center; Newark Coll. of Engineering, N. J.; and Rutgers - The State Univ., New Brunswick, N. J.
For primary bibliographic entry see Field 05G.
W69-08061

A STOCHASTIC MODEL OF MONTHLY RESERVOIR STORAGE,
City Univ., London (England).
For primary bibliographic entry see Field 04A.
W69-08062

6B. Evaluation Process

WATER AND METROPOLITAN MAN,
American Society of Civil Engineers, Cambridge, Mass. Urban Hydrology Research Council.
Stifel W. Jens, and D. Earl Jones, Jr.
Rep of 2nd Eng Found Conf on Urban Water Resources Res, Aug 12-16, 1968, Andover, N H, 1969. 90 p, 4 append.

Descriptors: *Water resources development, *Planning, *Urbanization, Systems analysis, Mathematical models, Social aspects, Legal aspects, Economics, Management, Water management (Applied).
Identifiers: Water resources research, Sociology.

The second conference on urban water resources research stressed the interdisciplinary and systems analysis approaches to solving urban water and pollution problems. Recommendations were made for action and for further research in communication, planning, social impacts, regulation, data collection, precipitation, storage, urban design, and systems analysis. (Knapp-USGS)
W69-07722

THE CHANGING VIEWPOINTS OF WATER RESOURCES PLANNING,
Board of Engineers for Rivers and Harbors, Washington, D. C.
Vernon L. Kimball.
Prepr 772, Amer Soc Civ Eng Annu Meet Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 27 p, 9 ref, append.

Descriptors: *Water resources, Project planning, Planning, *Attitudes, Social aspects, Decision making, Federal Government, State Governments, Local governments, Economics, Economic feasibility, Forecasting, Social values, Benefits.
Identifiers: *Regional planning, Regional authorities, Federal-State Cooperation, Appalachian Redevelop Act 1965.

Water resources planning is becoming more and more an intergovernmental effort including Federal, state, and local governments. Coordinating water resources planning with urban planning is becoming increasingly necessary. The regional type of planning authority will become more prevalent; the planner will be required to deal with factors other than water resources. This type of planning authority should build greater political acceptability into comprehensive water resource development plans. To meet the needs of future growth and improve the present environment, full use of our resources will be required. An increasing trend toward decentralization of water resources planning is evident. The past centralizing tendency at the Federal level is being reversed gradually by delegating authority to lower levels through greater use of Federal grants and other aid devices and through river basin commissions and regional authorities. The Federal planner will retain his responsible senior role under most of these new concepts. The best prescription for the planner is to recommend initial plans based on sound facts and professional judgment. Subsequently, he must follow closely a feedback process and revise his plans accordingly. (USBR)
W69-07783

SHOULD THE ENGINEER HAVE THE LEADING ROLE IN WATER RESOURCES PLANNING,
Minnesota Univ., Minneapolis.
Edward Silberman.
Prepr 803, Amer Soc Civ Eng Annu Meet Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 12 p, 9 ref.

Descriptors: Engineering, *Engineering personnel, *Leadership, *Water resources, Decision making, *Planning, Projects, Benefits, Professional personnel, Consulting engineers, Natural resources, Public opinion, Water resources development.
Identifiers: Cooperation.

The engineer must work as part of a water resources planning team with members of other disciplines (biologists, ecologists, and conservationists), as well as sportsmen in the planning process. As to who should lead the team, the answer does not lie in stating categorically that the engineer or any other specialist should be the leader. The leader is the man who can weld together successfully the many interests bearing on the problem under study. He must recognize what

the various interests are, and select effective representatives for each. The engineer should be a primary candidate because technical engineering problems are still the major problems in water resources development. The public recognizes that the engineer has a long history and much experience in leading such projects. The well-trained engineer is better qualified than practioners of most other disciplines to advise the planning group and public that every improvement has its cost and to state the relationship between the benefits and costs, even if they cannot be measured entirely in money. Although the leader frequently must play the role of mediator, he must not be a passive mediator if timely solutions for water resources problems are to be achieved. (USBR)
W69-07786

REAL COSTS AND REAL BENEFITS UNDER PRESENT FEDERAL WATER RESOURCES EVALUATION PROCEDURES,
Manitoba Univ., Winnipeg.
Gunter Schramm.
Pap, Eighth Annu Meet, Western Reg Sci Ass, Los Angeles, Calif, Feb 1969. 23 p, 2 fig, 3 tab, 18 ref, append.

Descriptors: *Real costs, *Real benefits, *Evaluation, Project planning, Economics, Benefit-cost ratios, Benefits, Prices, Projects, Hydroelectric power, Hydroelectric plants, Thermal powerplants, Alaska, *Economic feasibility, Capital costs, Inflation (Economic), Economic prediction, Water resources, Bibliographies, *Federal Project Policy.
Identifiers: Benefit-cost analysis, Rampart Dam (Alaska), Cost indexes, Yukon-Taiya Proj (Alaska).

The practice of using current rather than expected future price relationships in evaluating potential Alaskan hydropower developments is examined. The prevailing practice of evaluating benefits and costs in terms of present costs and prices may not only lead to an understatement of actual costs, but also may lead to gross inefficiencies in project selection. This danger is particularly great in cases of hydro projects with long-term project sequences depending on some common facility for their feasibility. While the need to estimate future price relationships may introduce new uncertainties into project evaluations, the use of prevailing prices is even less satisfactory. A somewhat inaccurate estimate of future changes backed up by a sensitivity analysis testing the effects of the assumptions on overall benefits and costs will provide a more realistic picture. This issue is important since the traditional cost advantage of hydro over thermal alternatives is disappearing. With dramatic cost reductions expected from future atomic powerplants, power system planners must take these expected changes explicitly into account. (USBR)
W69-07789

THE ECONOMICS OF AN UPPER YUKON BASIN POWER DEVELOPMENT SCHEME,
Manitoba Univ., Winnipeg.
Gunter Schramm.
Ann Reg Sci, Vol 2, No 2, pp 214-228, Dec 1968. 15 p, 3 fig, 3 tab, 22 ref.

Descriptors: Project planning, *Project feasibility, Economics, Electric power, Electric power production, Feasibility studies, Electric power costs, Electric power demand, *Hydroelectric power, Capital costs, Water resources development, Diversion tunnels, Alaska, Hydroelectric plants.
Identifiers: *International cooperation, *Yukon River, Alaska, Canada, *International projects, British Columbia, Canada, Taiya Valley (Alaska).

Since 1947, several investigations aimed at harnessing the power potential of the Upper Yukon by diverting headwaters through the coastal mountains have been conducted. Such diversion schemes appear attractive because the headwaters form a series of lakes at elevations of 2000 ft, less than 20 air miles from low-lying coastal river valleys. Three development proposals would divert water to the Taiya Valley in Alaska, and one proposal would divert water to the Taku River in British Columbia. Cooperation of the U S and Canada in developing the Yukon-Taiya Project could lead not only to a least-cost solution in engineering terms, but also to a least-cost solution in economic terms. Full advantage could be taken of the existing differential in labor and capital costs. Without cooperation, developing the project does not appear feasible; with cooperation, both countries could possibly obtain a source of energy priced low enough to be competitive. Availability of very low-priced at-site power would be conducive to economic development in southeastern Alaska and in the adjacent, mineral-rich areas of the Yukon and British Columbia. (USBR)
W69-07800

INSTITUTIONAL CONSTRAINTS ON THE DEVELOPMENT OF A REGIONAL WATER SUPPLY SYSTEM: THE CASE OF DETROIT,
Norman Wengert, and George M. Walker, Jr.
Fourth American Water Resources Conference, American Water Resources Association, New York City, November 1968. 19 pp.

Descriptors: *Institutional constraints, *Water supply, Regional analysis, Administrative agencies, Economies of scale, Decision-making.
Identifiers: *Detroit (Mich), *Regional system.

Detroit has had a regional water supply system since 1969. Its purpose was to enact a program which would realize economies of scale for the region resulting from a large integrated water supply system, which would include areas outside the corporate limits. Significant institutional constraints developed which effected the pattern of regional development. The three functions of the water utilities accounting are shared by the Detroit Metropolitan Water System and local governments. Production and transmission are handled by Detroit Metropolitan Water System while distribution is handled by local governments. Two limiting factors have effected the efficiency of this separation of function: (1) The definition of distribution service areas is arbitrary, hence removed from a consideration of regional efficiency factors with equal discrepancies in organizational administrative arrangements, and (2) there is dispersal of control over rates paid by the ultimate consumers. Separation of functions has brought intergovernmental politics and administration to the fore in Detroit Metropolitan Water System and has made it vulnerable to a variety of pressures. In some cases regional efficiency and fairness is sacrificed in an attempt to deal with local governments. A case study of Flint is given as an example of the kinds of negotiations and issues involved in building the regional system. (Marriott-Chicago)
W69-07871

FIFTH WATER RESOURCES PROGRAM.
Delaware River Basin Commission, Trenton, N. J.

Delaware River Basin Commission, Trenton, New Jersey, March 1968. 153 pp, 17 fig, 31 tab, 93 ref, 6 append.

Descriptors: *Water supply, *Water demand, *Delaware River Basin Commission, Water management programs, Applied projects, Underground streams, Surface waters, Water transfer, Recreation facilities, Electric power production, Navigation, Flood control, Water quality control, Non-structural alternatives, Withdrawal, Wildlife, Fish.
Identifiers: *Delaware River Basin.

The report discusses prospective needs for water and related resources in the Delaware River Basin through the year 2010. It identifies the areas of need and proposes construction or development of projects that will be required in the next six years for the optimum development and utilization of the Basin's water resources. Chapter I summarizes findings, draws conclusions, and recommends that the Commission complete specific projects and studies and continue to endorse early acquisition of lands needed for future projects. Chapter II considers the effects of location, quantity, quality, and time on water supply. It analyzes underground sources and surface streams, and considers the effects of importation and exportation on supply. Chapter III discusses available water-related resources, including natural and improved facilities for recreation, electric power generation, navigation, flood control, and water-quality control. Chapter IV discusses demands for water withdrawals, instream water demands, and demands for related products and services. Chapter V establishes the need for water resources management. It discusses increasing withdrawal demands, flood control, power, recreation, fish, and wildlife, water-quality control, and specific needs in each sub-basin. Chapter VI recommends projects and programs for Commission endorsement, and highlights the need for non-structural programs for flood-loss reduction. (Gossen-Chicago)
W69-07872

WATER RESOURCE DEVELOPMENT IN CALIFORNIA: THE COMPARATIVE EFFICIENCY OF LOCAL, STATE, AND FEDERAL AGENCIES,
Resources for the Future, Inc., Washington, D. C.
Joe S. Bain.
For main entry see Vol 1, No. 12, Field 6B, W69-05115. In Water Research, Johns Hopkins Press, Baltimore, 1966, pp 51-67. 5 tab, 2 ref.

Descriptors: *Economic efficiency, *Inter-agency cooperation, California, Water resources development, Central Valley Project, Federal jurisdiction, State jurisdiction, Marginal benefits, Water distribution (Applied), Cost-benefit analysis.
Identifiers: Feather River Project, Local jurisdiction.

There are two spheres of water developers in California's Central Valley: local public agencies; and federal and state producer-wholesalers. They have little interdependence. Federal-state agencies have some inherent advantages but encountered the disadvantages of being later developers. Classified economically, opportunities available to federal and state agencies were: (a) numerous marginal or submarginal opportunities for independent action; (b) a few better opportunities for augmenting local developments of rivers, which were complicated by tangled water rights situations; and (c) even fewer better opportunities which local agencies had by-passed because of expense. The two spheres are separately analyzed for: the level of development; the character of water allocation among types, sites, and times of use; and allocation among different users of given types. In eighteen irrigation districts administered by local agencies, average revenue was appreciably below long-run average cost. These districts have either over-allocated water for their own lands or maldistributed water among irrigators. Benefit-cost analyses of the basic features of the Central Valley Project, and the Feather River Project show that the federal and state projects are equally inefficient as local projects. (Gossen-Chicago)
W69-07873

POLITICS AND EFFICIENCY IN WATER DEVELOPMENT,
Resources for the Future, Inc., Washington, D. C.
Hubert Marshall.
For main entry see Vol. 2, No. 12, Field 6B, W69-05115. In Water Research, Johns Hopkins Press, Baltimore, 1966, pp 291-310. 24 ref.

Descriptors: *Ethics, Decision making, Political aspects, Economic justification, Economic efficiency, Appropriation, Social aspects, Professional personnel, Professional societies, Engineering education.
Identifiers: *Professionalization, U.S. Congress, President of U.S.A., Army Corps of Engineers, Bu-

reau of Reclamation, Soil Conservation, Organizational structure.

The report examines the procedures used by construction agencies–the Corps of Engineers, the Bureau of Reclamation, and the Soil Conservation Service--to justify projects and secure appropriations. It is concluded from a substantial body of literature that the economic-efficiency justifications of projects have either inflated benefits or deflated costs. The distortion is well-known in Congress, but ignored because of constituency demands for public works. The President could correct the distortion by changing the economic-evaluation criteria embodied in Senate Document 97; but political costs make such an action unlikely. Within the construction agencies, group forces maintain cost-benefit distortions. The report recommends professionalization in decision-making. Professionalization has four characteristics: (1) criticism comes from colleagues of the same training rather than a lay superior; (2) professionals have no personal interest that would influence their decisions; (3) professions are oriented toward community interest; (4) professions instill in their members ethical codes. Engineers are professionals but make little resistance to distorted benefit-cost ratios for three reasons: (1) a definite body of professional knowledge is not yet established; (2) engineers receive inadequate training in economics; (3) agency personnel find little explicit moral guidance in the Code of Ethics of the American Society of Civil Engineers. (Gossen-Chicago)
W69-07876

MAJOR RESEARCH PROBLEMS IN THE SOCIAL SCIENCES,
Resources for the Future, Inc., Washington, D. C.
Stephen C. Smith.
For main entry, see Vol. 2, No. 12, Field 6B, W69-05115. In Water Research, Johns Hopkins Press, Baltimore, 1966, pp 503-508. 3 ref.

Descriptors: *Research and development, *Water resources development, Organizations, Decision making, Social aspects, Social participation, Investment, Optimization, Water utilization, Political aspects, Water law.
Identifiers: *Social sciences.

The article identifies several topics for research. A major never-ending task is to identify significant systems and subsystems of organized social action with reference to water resources, and to understand the dynamics and interaction of these systems. A specific problem is the jump between criteria evaluation and hard decision. Fundamental multi-discipline studies in identifying appropriate decision systems in which evaluative criteria can function are recommended. The social role of water in public and private behavior must be clarified, because two conflicting concepts of water development exist. The one used is 'Governments invest to remove water as a constraint to private development.' The one desired is 'We seek an economically optimal water resource allocation within region x and time y.' The sociologist should adapt the spread of 'practices research' to water use, in order that water shortage may be offset by efficient use. Questions of social organization and the handling of conflict deserve attention. Power relationships among the political entities associated with water resources must be studied. Water law must be ordered. Non-monetary criteria must be better defined. All research should be carried to the operational stage where possible. (Gossen-Chicago)
W69-07877

COASTAL WATERS AND THE NATION,
National Council on Marine Resources and Engineering Development, Washington, D. C.
Edward Wenk, Jr.
Civil Eng, Vol 39, No 6, pp 52-55, June 1969. 4 p.

Descriptors: *Planning, *Land use, Coasts, *Coastal marshes, *Beaches, Coastal plains, Recreation, Industries, Fishing, Agriculture, Management, Land resources, Urbanization, Governments, Water pollution.
Identifiers: Coastal land uses, Land use planning.

The states in the U.S. Coastal Zone contain most of the nation's population and industry, the gateway for maritime trade of about $40 billion, the staging area for the $500 million fish and crustacean industry, and the locus for the billion-dollar offshore oil and gas industry. The task is to balance 2 factors--demands for development and more subtle esthetic natural-resource and recreational needs. Each year, tens of millions of people turn to the sea for recreation. The zone as a resource is shrinking and subject to degradation: a site of marshlands ready for filling, a convenient sink for wastes (already 10% of the coastal waters are lost for shellfish culture, because of pollution), the site of an oil-tanker wreck and a runaway underwater oil well. The need is for planning--rational weighing of the demands for development against the values obtained by preservation. The Federal Government is attacking the problem by undertaking studies and by considering merits of the idea of state managed Coastal Zone Authorities to plan and regulate land and water use. The states have the lead role as they now have the legal jurisdiction over most coastal resources, but need better coordinated and stronger agencies as well as more aggressive action. (Knapp-USGS)
W69-07923

WATER AND CHOICE IN THE COLORADO BASIN,
National Academy of Sciences, Washington, D. C.
For primary bibliographic entry see Field 06D.
W69-07925

MINERAL RESOURCES OF THE WORLD OCEAN.
Geological Survey, Washington, D. C.; Rhode Island Univ., Newport; and Department of the Navy, Washington, D. C.

Keiffer, Elisabeth, Editor. Proc Symp on Mineral Resources of World Ocean, Rhode Island Univ Nav War Coll, July 11-12, 1968, Newport, 1968. 108 p, 40 fig, 5 plate, 2 tab, 108 ref. N00014-68-C-0439 (NR083-240).

Descriptors: *Conferences, *Oceans, *Continental shelf, *Political aspects, Sea Water, Marine geology, Continental slope, Mineral industry, Natural resources, Technology, Engineering, Resource development.
Identifiers: *Symposium, *Marine mineral resources, Policy considerations.

Presents 15 papers and comments resulting from the first conference of its kind. Co-sponsored by the U.S. Geological Survey, the University of Rhode Island, and the Navy, the meeting brought together representatives from science, industry, government and the military to discuss the ocean environment and the problems and possibilities in recovery of mineral resources from the ocean. The symposium was divided into 4 parts: Ocean-geologic Times, Mineral Resources, New Technology and Engineering in the Oceans, and Public Policy Questions. Included in the Proceedings are reports on marine geology of continental shelves and slopes; mineral potential including petroleum, tin, and seawater as a raw material; problems in developing minerals; and national and international considerations relating to ocean mineral resources. (Lang-USGS)
W69-07973

FUTURE WATER SUPPLY-FACILITIES, METROPOLITAN WASHINGTON REGION,
Metropolitan Washington Council of Governments, D. C. Board of Engineers.
Richard Hazen, Thomas M. Niles, Roy H. Ritter, and Abel Wolman.
Available from Clearinghouse as PB 182 307 at $3.00 in paper copy and $0.65 in microfiche. Metrop Wash Counc Governments, Board of Eng Rep No 2, Dec 1968. 74 p, 6 fig, 11 tab.

Descriptors: *Water demand, *Water supply, *Water sources, *Water distribution (Applied), *District of Columbia, Virginia, Maryland, Networks, Water sources, Water conveyance, Water delivery, Water management (Applied), Water works, Public utilities.
Identifiers: Washington D. C. Metropolitan area.

Beginning with the assumption that the recommendations presented in Report No. 1 dated May, 1967 will result in development of an adequate supply of raw water to the Region, Report No. 2 estimates the quantities of water that will be required by the various systems serving the Washington Metropolitan Region to 2010. It makes general recommendations concerning the facilities needed to meet those developing water requirements. Existing facilities of the systems are surveyed, and individual chapters are devoted to the District of Columbia, the Washington Suburban Sanitary District (Montgomery and Prince George Counties in Maryland) and the Fairfax County (Virginia) Water Authority, the three systems that supply 95 percent of the water. Attention is devoted to the need for emergency interconnections among the systems and to the extension of Washington Aqueduct service to some of the Virginia systems. Matters of organization and finance are also discussed. (Knapp-USGS)
W69-08024

PERCEPTION AND PUBLIC POLICY IN THE RECREATIONAL USE OF DOMESTIC WATER SUPPLY RESERVOIRS,
Southern Illinois Univ., Carbondale.
Duane D. Baumann.
Water Resources Research, Vol 5, No 3, pp 543-554, June 1969. 12 p, 4 fig, 2 tab, 31 ref.

Descriptors: *Recreation, *Domestic water, *Water supply, Reservoirs, Water management, Management, Diseases, Environmental sanitation, Legal aspects, Northeast US, Epidemics.
Identifiers: *Managerial perception, *Water pollution, *Public policy, *Recreational use, *Water managers, Consumer, Recreational activities, Social guides.

In the Northeast and Far West, recreational activities are usually prohibited from domestic water supply reservoirs. Water managers perceive recreation to be incompatible with the production of safe, potable water. Public attitudes are opposed to such reservoir use and the state health departments are influential in the formation and perpetuation of the restrictive policies and laws of recreation on domestic water supply reservoirs. In the remainder of the country, recreational activities are not only allowed on domestic water supply reservoirs, but the water managers do not consider reservoir recreation as inimical to the hygienic and aesthetic qualities of the drinking water. The public favors such reservoir use. Within each region, managerial perceptions of recreation on municipal water supply reservoirs were demonstrated to be a function of the manager's evaluation of water treatment technology, recreation as a source of pollution, managerial problems, and the economics of providing recreation. These in turn were influenced by the formal and informal social guides. From a literature review, the writer concludes that all recreational activities can be permitted on domestic water supply reservoirs without any measurable increase in the risk of water-borne disease if the water is properly treated. (Loeb-Rutgers)
W69-08060

CLASSIFICATORY NOTES ON THE PRODUCTION AND TRANSMISSION OF TECHNOLOGICAL KNOWLEDGE,
Harvard Univ., Cambridge, Mass.
Kenneth J. Arrow.
American Economic Review, Vol 59, No 2, pp 29-35, May 1969. 7 p, 12 ref.

Descriptors: Resource development, Technology, Risks.
Identifiers: *Production of knowledge, *Transmission of knowledge, *Technological knowledge, Production function, Technological change, Factor augmentation.

Economists could leave the analysis of production function with the assertion that the causes which determine the amount of technological knowledge at any one time and place are as much outside their province as the tastes which determine consumption patterns. However, we know that significant quantities of resources are being expended by profit-making institutions on research and development. Hence, it is suggested that we must regard the body of technological knowledge as the results as well as the cause of economic changes. A model of the form: $Y = F(A(t)K, B(t)L)$, where Y is output, K is capital, L is labor, and A (t) and B (t) are the total augmentations of capital and labor, respectively, has been suggested. Knowledge, as reflected in A and B appears as an input. It is the suggestion of this paper that such models do not capture the essential features of the creation and transmission of knowledge. Technological progress is in the first instance the reduction in uncertainty. Research and development is thus intimately connected with the problems of uncertainty reduction. Water projects, like others, are housed in uncertainty and as such, a usable model which takes into account uncertainty, would be most helpful to decision makers contemplating investments in water projects. (Loeb-Rutgers)
W69-08063

THE ECONOMIST AND THE 'NEW' CONSERVATION,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 03D.
W69-08072

THE FRESH WATER OF NEW YORK STATE: ITS CONSERVATION AND USE.
State Univ. of New York, Buffalo.

Wm C Brown Book Co, Dubuque, Iowa, 1967. 255 p. Lauren B. Hitchcock, Editor.

Descriptors: *Water resources, *New York, *Conservation, River basins, Water pollution, Water management, Limnology, Economics, Government finance, Water quality control, Water pollution control, Energy, Great Lakes, Legal aspects, River basin development, Hudson River, Water quality.
Identifiers: Urban planning, Long Island.

The book is composed of papers by nationally distinguished authorities in the field of water resources and others who participated in a symposium directed primarily at the challenges confronting New York State, but applicable in many cases, to water problems existing nationally and abroad. A summation was presented of where we stand today, which could help resolve some uncertainties, crystallize public opinion, and alert those in government and community life who may still view these water problems with a degree of apathy. The symposium brought together representatives of virtually all fields concerned with our water resources. These included pollution causes and control, water resources management, limnology, hydrology, economics, urban planning, and government. Emerging from this Symposium is the inescapable inference that not much will be accomplished until the federal government finances a much larger portion of the multi-billions required to construct municipal and industrial treatment works, paralleling the country's experience in its expanded program of highways. (See also W69-08077 thru W69-08083). (Loeb-Rutgers)
W69-08076

WHERE NEW YORK STATE STANDS TODAY IN WATER RESOURCES,
State Univ. of New York, Syracuse. Coll. of Forestry.
H. G. Wilm.
The Fresh Water of New York State: Its Conservation and Use, pp 3-9, Wm C Brown Book Co, Dubuque, Iowa, 1967. 7p. Edited by Lauren B. Hitchcock.

Descriptors: *New York, *Water resources, Regions, Floods, Runoff, Erosion, Sediments, Water pollution, Water storage, Water distribution, Planning, Water supply.
Identifiers: Water ownership, Water resources research.

The author discusses New York State's water resource situation, the major problems which it faces, and the steps that are being taken to meet them. The paper first investigates the general water situation in New York State, making necessary comparisons with other regions, and discussing total quantities; floods and accelerated run off, as contrasted with shortages; erosion and sediment; and pollution. Intimately tied in with these variables are the problems of shortage and distribution of water. The author then discusses the ownership of water, including some fallacies in popular conceptions of water ownership in the East. The last part of the paper deals with the various kinds of water resource planning and research that are being conducted in New York State and with activities that are essential for the immediate and more distant future, so that New York State may have ample supplies of clean usable water for the expanding population. (See W69-08076). (Loeb-Rutgers)
W69-08077

PLACE OF WATER RESOURCES PLANNING IN ECONOMIC REGIONAL DEVELOPMENT,
Cornell Univ., Ithaca, N. Y.
David J. Allee.
The Fresh Water of New York State: Its Conservation and Use, pp 170-180, Wm C Brown Book Co, Dubuque, Iowa, 1967. 11 p, 1 fig, 1 disc. Edited by Lauren B. Hitchcock.

Descriptors: *Planning, Investment, Costs, Regions, Industrial water, Productivity, Water resources, Water utilization.
Identifiers: *Economic regional development, Social overhead capital, Growth, Substitutes, Regional growth, Recreational water use, Agricultural water development.

Social overhead capital, which includes much of the investment being planned for water resource development, is a permissive influence on growth, operating largely through the cost structure for directly productive activities. Being only a part of the effort implies that water should be coordinated with other public investment policy. Vigorous planning is crucial in a mature economy because it is probably the expectation of social overhead capacity that is an significant to private investment as existing excess capacity. Regions with relatively small economies are likely to be more concerned with export base effects of water development. Larger regions in addition have an interest in effects on shifts between sectors caused by increased productivity and income. Even when substantial increases in the volume of economic activity do not seem probable it should be possible to increase per capita incomes through increased investment and productivity. The general plea of this paper is to improve our planning analysis and particular our economic analysis, to consider more precisely growth and income distribution goals, at least, in addition to the traditional considerations of efficiency. (See also W69-08076). (Loeb-Rutgers)
W69-08081

WATER RESOURCES MANAGEMENT,
Kansas Univ., Lawrence.
Ross E. McKinney.
The Fresh Water of New York State: Its Conservation and Use, pp 185-189, Wm C Brown Book Co, Dubuque, Iowa, 1967. 5 p. Edited by Lauren B. Hitchcock.

Descriptors: *Planning, *Water management, Water supply, Technology, Social aspects, Legislation, Water pollution, Domestic water, Industrial water, Recreation, Flood control, Navigation, Water quality, Water treatment.
Identifiers: Power generation.

The author contends that the real need in water resources management is for a combined background in technology and sociology. The solving of water problems is as much a sociological problem as a technical problem. Our water problem has grown because we have failed to respond with imaginative leadership and responsible management. The water problem will continue to grow unless immediate action is taken to solve the problem. Unfortunately, too many people have too many self interests to permit a proper approach to water management. The author contends that water management problems cannot be solved by legislation or by money alone. These problems can be solved only by people with ideas and dedication. (See W69-08076). (Loeb-Rutgers)
W69-08082

THE ROLE OF WATER IN CIVIC PLANNING,
New York City Temporary Commission on City Finances, N. Y.
George H. Deming.
The Fresh Water of New York State: Its Conservation and Use, pp 199-203, Wm C Brown Book Co, Dubuque, Iowa, 1967. 5 p. Edited by Lauren B. Hitchcock.

Descriptors: *Planning, Water management, New York, Economics.
Identifiers: *Civic planning, Urban development, Shortages.

New York State will build by the year 2000 an urban economy equivalent to that achieved in the past 175 years. In this development, water management is but one of the many factors to be accommodated. Historically, water management has played a relatively minor role in urban development. Rather, a laissez-faire approach has been the predominant pattern. Only lately has the concept of water as a resource held in public trust had much acceptance. Water management as a public function has been administered through a wide range of organizational forms. It lends itself to an 'aspect of function' approach and divided responsibility among units and levels of government. The fruits of economic research will play a major role in conditioning our future patterns and may well dictate an evolutionary pattern of organization. A major hindrance to optimal planning effort is the significant shortage of skills and manpower. These shortages must be resolved if progress is to be realized. (See also W69-08076). (Loeb-Rutgers)
W69-08083

THE COLUMBIA RIVER TREATY, THE ECONOMICS OF AN INTERNATIONAL RIVER BASIN DEVELOPMENT,
Resources for the Future, Inc., Washington, D. C.
John V. Krutilla.
Johns Hopkins Press, Baltimore, Maryland, pp 1-211, 1967. 211 p, 26 fig, 34 tab.

Descriptors: *Costs, *Benefits, *Administration, *International Joint Commission, *Columbia River Basin, United States, Columbia River, Flood control, River basin development, Engineering, Economics, Technology, Political aspects, Negotiations.
Identifiers: *Columbia River Treaty, Canada, Power production, International agreement, Thermal component, Strategy, National resources.

Formal approval of the Columbia River Treaty in 1964 brought to a conclusion two decades of study and negotiation by the United States and Canada for joint development of the Columbia River Basin. The Treaty provides the framework for one of the most far-reaching water development efforts in North America. The engineering and economic

studies made in preparation for international agreement on so complex an undertaking as the Columbia were concerned with the selection of sites, the timing of project construction, and the division of costs and benefits between the upstream and downstream countries. The negotiations were protracted. The issues involved not only the interests of the United States and Canada, but also those of British Columbia. Also, in the course of two decades changing technological, economic, and political conditions in both countries were factors complicating the final decisions. In this book, Krutilla reviews the process by which the Treaty came into being and analyzes the economic implications of the terms. The book, besides being an independent economic appraisal of a major undertaking in international river development, is a case study of value to future international development efforts and a contribution to understanding the economics of water management. (Loeb-Rutgers)
W69-08084

BRETON AND WELDON ON PUBLIC GOODS,
Virginia Univ., Charlottesville.
James M. Buchanan.
Canadian Jour of Econ and Pol Sci, Vol 33, No 1, pp 111-115, Feb 1967. 5 p.

Descriptors: Classification, Marginal costs, Consumptive use, Benefits.
Identifiers: *Public good, *Non-private good, *External economies, *Allocative norms, *Joint supply, *Utility functions, Public intervention, Pareto optimality.

The author reverses the emphasis of Weldon to say that anything which produces public intervention in the supply of a good insures its public quality. To demonstrate this the theory is applied to a good that is acknowledged to be purely private in the descriptive sense. With the proper definition of units, 'shoes' are treated as a purely public good. The basic distinction that is necessary for this is one between units in production and units in consumption. With a purely public good, the quantity of consumption units available to each person is measured by the total production. An impure good, enters the utility functions of several members of the political community. Evaluations placed on this good will vary among individuals, not only because of differences in the utility functions, but also because of differences in their physically measurable service flows (consumption units). If individual evaluation of a particular quantity depends on individual projected utilization, to add an argument measuring this utilization, as Weldon suggests, seems redundant to the author. This argument has relevance for government provision of adequate water supply as water resources are often considered to have significant public goods aspects. (Sokoloff-Rutgers)
W69-08085

ECONOMIC EVALUATION OF PUBLIC IRRIGATION DEVELOPMENT,
Economic Research Service, Washington, D. C.
For primary bibliographic entry see Field 03F.
W69-08086

THE VALUE OF WATER IN ALTERNATIVE USES WITH SPECIAL APPLICATION TO WATER USE IN THE SAM JUAN AND RIO GRANDE BASINS OF NEW MEXICO.
New Mexico Univ., Albuquerque.

Albuquerque, The University of New Mexico Press, 1962. 426 p, 8 fig, 200 tab, 13 append. Nathaniel Wollman, (Editor).

Descriptors: *Water values, Recreation, Southwest U S, Prices, Profit, Cost-benefit analysis, Municipal water, Industrial water, Employment, Appreciation, Population, Income, New Mexico, Costs, Model studies, Cost-benefit ratio.
Identifiers: *Alternative uses, San Juan Basin, Rio Grande Basin, Mineral resources, Recreational uses, Primary effects, Secondary effects, Capital requirement, Savings.

The large number of government reports, commissions, symposia, and regional, national, and international conferences devoted to the subject of water indicates an emerging awareness of water as a controlling factor in economic growth. While different specialists have their own views of the 'problem,' its core lies in the growing disparity between the supply and demand for water. Our consumption of water has been growing more rapidly than the increase in population, a state of affairs that has accelerated the pressure on the water supplies of the semiarid parts of the country, notably the Southwest. As a result of the current state of militancy, the new technology of war, and the search for climatic amenities, population has been growing rapidly in those areas in which water shortage historically has been a chronic problem. The present study was prompted by presentiments that the growing shortage of water in certain parts of the country will raise a barrier against sustained economic growth and mobility, and the current experience of the Southwest, where the shortage of water has always been apparent, should help forecast what can be expected over a wider area at a later date. (Loeb-Rutgers)
W69-08087

RESOURCES DEVELOPMENT: FRONTIERS FOR RESEARCH.
Western Resources Conference, Boulder, Colo.

University of Colorado Press, Boulder, pp 1-333, 1960. 333 p, 16 fig, 10 tab, 3 append. Edited by Franklin S. Pollak.

Descriptors: *Resource development, Irrigation, Water utilization, Electricity, Costs, Water supply, Planning, Colorado, Colorado River, Water resources development, Groundwater, Water law, Land use, Mineralogy, Energy, Recreation, Conservation.
Identifiers: *Western Resource Conference, *Atomic energy, Land policy, South Platte River, Arizona v California, River system planning.

The papers presented in this volume were originally presented at the Western Resources Conference held in Boulder in the summer of 1959, under the sponsorship of the University of Colorado, Colorado State University and the Colorado School of Mines. That conference and this book represent a decision by the three sponsoring institutions that the West needs greater knowledge about its resources and that they have a duty to provide it. They plan, therefore, a continuing program on the West's resources, dealing with both conservation and development--a program of instruction and research, supplement by conferences and publications. The topics chosen for the first conference were five major resources--water, land, recreation, resources, minerals and energy and research in relation to resources. The speakers were from a variety of organizations and occupations: universities, the Federal Government, state government and municipal government, Resources for the Future, industry, the private practice of law and engineering. (See also W69-08089 thru W69-08092). (Loeb-Rutgers)
W69-08088

POTENTIAL APPLICATIONS OF NEW WATER TECHNOLOGY IN THE WEST.
Resources for the Future, Inc., Washington, D. C.; and Wisconsin Univ., Madison. Solar Energy Lab.
George O. G. Lof.
Resources Development: Frontiers For Research, pp 39-48, University of Colorado Press, Boulder, 1960. 10 p, 2 tab. Edited by Franklin S. Pollak.

Descriptors: *Technology, Industrial use, Water reuse, Water demand, Water supply, Sea water, Atmosphere, Groundwater, Evaporation.
Identifiers: *Water technology, *Western States, Industrial re-use.

Some new or not yet widely applied methods for increasing the availability of water for men's needs may have particular importance in the Western States. These methods fall into two categories. Applicationof one group of techniques adds to our present supply by reaching new sources or obtaining greater quantities from old sources. The second set of methods permits use of our present supply more effectively. The need for considering ways to augment water availability is real and immediate since our demand for water is increasing rapidly. As such, the subject of increased water supply, through procurement of more water and the better use of existing supplies is of growing concern. The author contends that the United States is not going to run out of water or be faced with a formidable water crisis, for new technology and better and wider application of older technology is going to keep up reasonably well with the requirements. In some localities there will be major difficulties, but none should be insurmountable. The author states that it should be possible to choose a place at random and obtain water at that point, at costs low enough to make it useful for municipal supply. (See also W69-08088). (Loeb-Rutgers)
W69-08089

WATER-RESOURCE DEVELOPMENT, THE ECONOMICS OF PROJECT EVALUATION,
Harvard Univ., Cambridge, Mass.
Otto Eckstein.
Cambridge, Massachusetts, Harvard University Press, 1958. 300 p, 15 fig, 55 tab, 134 ref.

Descriptors: *Water resource development, *Flood control, *Irrigation, *Navigation, *Electric power, *Joint costs, Project purposes, Income, Benefits, Costs, Welfare, Cost-benefit analysis, Political aspects, Social aspects, Risks, Resource allocation.
Identifiers: *Project evaluation, Bureau of Reclamation, Department of the Interior, Army Corps of Engineers, Income distribution, Harbor improvement.

This study analyzes the procedures for measuring benefits and costs employed by two major agencies which are building federal water-resource projects: the Bureau of Reclamation of the Department of the Interior and the Corps of Engineers, U S Army. The analysis is based on the theory of welfare economics. It treats benefit-cost analysis as a means of testing the quality of a project and of selecting the most desirable projects from the point of view of economic efficiency. It is assumed that judgments about changes in the distribution of income and about the political and social objectives must be left to Congress and to administrators, and that the national interest is best served by benefit-cost analyses which reveal each project's impact on the total real national income to be enjoyed by the country. (Loeb-Rutgers)
W69-08093

OUR NATION'S WATER RESOURCES--POLICIES AND POLITICS,
Chicago Univ., Ill.
Ben Moreell.
Chicago, University of Chicago, 1956. 266 p.

Descriptors: *Federal Reclamation Law, *Electric power, *Water resources, *Water policy, Navigation, Reclamation, Flood control, Demand, Conservation, Irrigation programs, Capital, Financing, Colorado River Basin, Capital costs, Columbia River, Cost allocation, Hoover Dam.
Identifiers: *Federal Power Developments, *TVA, Hoover Com, Sacramento River Project.

This is a collection of lectures given by the author at the University of Chicago. The lectures are concerned with water resources and water power as well as the role of the several levels of government-federal, state and local--in a desirable program of

conservation and development. Their purpose is to further the most economic use of water resources possible. Thus, each project must pass the test of economics in deciding whether it is waste or conservation. The book reviews past and present federal water policies with mention of the accomplishments of the different agencies. The role of the Federal government in the area of navigation, reclamation and flood control as well as the economics of federal power developments are reviewed and discussed. The book concludes with a discussion of the findings of the Hoover Commission Task Force. (Murphy-Rutgers)
W69-08094

THE PERCEPTION OF NATURAL HAZARDS IN RESOURCE MANAGEMENT,
Toronto Univ., (Ontario); and Clark Univ., Worcester, Mass.
Ian Burton, and Robert W. Kates.
Natural Resources Journal, Vol. 3, pp 412-441, January, 1964. 20 p, 5 fig, 5 tab, 54 ref.

Descriptors: *Attitudes, Flooding, Administration, Frequency, Water users, Scientific personnel, Rural areas, Coastal plains, Flood plains.
Identifiers: Natural hazards, Magnitude, Urban areas.

The article is a study of variations in the perception of natural hazards, and of ways in which it affects resource management. Section I defines natural hazards as elements in the physical environment, harmful to man and extraneous to him. Section II classifies natural hazards by their principal causal agent. Section III discusses the magnitude and frequency of hazards. Variations in attitude cannot be explained directly in terms of magnitude and frequency. Section IV considers within-group and between-group variations of two groups: resource users and technical and scientific personnel. Difference in perception are found between agricultural and urban flood-plain users and between coastal and flood plain users. Widespread divergency exists between the perception of flood hazard of technical-scientific personnel and resource users. Resource users often discount the possibility of recurring floods, and reject plans for protection, even when the monetary cost is non-existent. Three reasons for divergence in hazard evaluation are suggested: (1) some users reflect divergencies among scientists; (2) some diverging perceptions are based on different basic attitudes toward nature; and, (3) the mobile user need not be concerned about an area. (Gossen-Chicago)
W69-08099

FRAMEWORKS OF DECISION MAKING,
Chicago Univ., Ill. Dept. of Geography.
Gilbert F. White.
Johns Hopkins University, Water Management Seminars, October 1964 to May 1965. pp 331-344, 14 p, 3 tab, 1 fig, 4 ref.

Descriptors: *Water resources development, *Non-structural alternatives, *Decision making, Water demand, Water supply, Research and development.
Identifiers: *Alternative actions, Perceived needs.

The growing gap between scientific technology and practical application is acknowledged as one of the major problems confronting a solution to water resource problems. The failure of much water management in the United States is attributed to the methods by which decisions are made. This method often leads to two kinds of results: (1) failure of predictions to be realized; and, (2) ignoring opportunities for more fruitful management. The way in which a problem is stated very often determines the results achieved. One of the disadvantages inherent in most economic optimization analyses is the assumption that water managers make rational choices based on decision criteria aimed toward maximization of their profits. This method often excludes interesting alternatives which have not been canvassed but have proven feasible. Perception of needs influence choice as does estimation of the resource and perception of the technology available. The point is made that people who are using the water take a different view of how the water is managed than do the public officials. Suggested by the author is a framework for examining decisions that would be applied first to the resource managers, second to the public agency and third an idealistic framework for the 'objective' student of the situation. Two essential needs are proposed: (1) means by which can be developed greater predictive capacity to anticipate what actions will be taken by resource managers; and, (2) need for research to develop methods of finding a wider range of alternatives and examining their applications. (Starr-Chicago)
W69-08101

SOME ASPECTS OF PUBLIC ORGANIZATION FOR WATER MANAGEMENT,
Syracuse Univ., N. Y. Dept. of Political Science.
For primary bibliographic entry see Field 06E.
W69-08103

COMPREHENSIVE, MULTIPLE PURPOSE WATER RESOURCES DEVELOPMENT,
Corps. of Engineers, Washington, D. C.
Harry A. Schwarz.
Johns Hopkins University, Water Management Seminars, pp 189-196, October 1964 to May 1965. 8 p, 4 ref.

Descriptors: *Water resources development, *River basin development, Project planning, Project purposes, Data collections.
Identifiers: *Alternative goals, Comprehensive planning.

Resource planning for an entire river basin is seen as a problem in environmental engineering. Four distinct steps are identified: (1) identifying the objectives; (2) translating these objectives into specific goals; (3) formulation of a plan; and, (4) evaluation and analysis of the plan to determine the consequences. Since objectives may be conflicting rather than complimentary, a balance must be achieved through the assignment of priorities. The author distinguishes between goals and objectives by asserting that objectives are broad, general statements and goals are measurable, specific items deduced from the broad objective. The formulation of a plan is viewed as the traditional role of engineering planning in which benefits are maximized and costs are minimized. The analysis and evaluation of the consequences of a plan should incorporate in addition to monetary costs and benefits, the social and aesthetic ones, the consequences of alternatives or of inaction, and the effectiveness of the plan in the light of the objectives. The goal of basin planning for the actual planner is described in seven steps: (1) planning for planning; (2) collection of data; (3) determination of needs; (4) determination of capabilities; (5) formulation of a tentative plan; (6) evaluation and refinement of the plan; and, (7) report on the plan. Since the final decision is usually made by some one in the political process other than the planner, the author stresses the importance of writing a plan that is simple enough to be clear to the laymen yet detailed enough for the review by expert. (Starr-Chicago)
W69-08104

THE ECONOMICS OF WATER RESOURCES INVESTMENT,
Pittsburgh Univ., Pa. Center for Regional Studies.
Charles Leven.
John Hopkins University, Water Management Seminars, pp 155-167, October 1964 to May 1965. 13 p, 5 ref.

Descriptors: *Cost-benefit analysis, *Project benefits, *Values, *Economic efficiency, Social aspects, Water resource development, Federal project policy.
Identifiers: *Alternative objectives, Perceived needs.

Discussed is what the author assumes to be the core economic problem in water resource development -- the problem of choice. The author proposes that the reason emotions run so high vis-a-vis water problems is the fact that there is the feeling that there is little chance of success in bringing about the changes they see as important -- increased water recreation; controlling river and stream pollution; preserving an adequate supply. Therefore, in terms of a generalized society-wide interest, some kind of criteria should be developed as an objective crisis for meeting these perceived needs. These would examine the consequence of alternative decisions in terms of effects on particular things which people regard as important. Example: The impact not only of building a dam but the impact of the services flowing out of the investment once it has been completed. Water resource development prospects will provide obvious primary benefits -- making recreational water available; protecting lands from floods, etc. The problem exists in ignoring the secondary benefits -- the effect on the economy of the area in which the project is located which makes it attractive for a business to open there. The second problem in ignoring project effects is the implication that the Nation's economic welfare is correlated with the Nation's gross national product. Examined also is federal resource investment policy which has substantial impact on the way in which both population and industry are located. (Starr-Chicago)
W69-08105

BACKGROUND OF THE WATER RESOURCES PROBLEM,
Resources for the Future, Inc., Washington, D. C.
Irving K. Fox.
Johns Hopkins University, Water Management Seminars, pp 13-23, October 1964 to May 1965. 11 p, 5 ref.

Descriptors: *Social aspects, *Political aspects, *Economics, Institutional constraints, Water resources development, Water supply.

Value considerations are central to problems associated with water resources. Recognition should be given to the fact that there are many kinds of values related to water. Some values are more difficult to measure than others, such as the value of good health resulting from clean water; the value of the aesthetics of a beautiful river, and the value of making certain decisions about water through democratic political process. The author proposes that the water problem is not a problem of shortage of water but the ineffectiveness of policies and institutions in achieving the more intangible values. Discussed are the limitations of traditional economic institutions, the history of efforts to develop political institutions to complement the conventional economic institutions, the trend toward federal domination of river basin programs, and the trend toward more comprehensive programs. (Starr-Chicago)
W69-08106

CONFLICTS WITHIN RECREATION: AN EMERGING PROBLEM IN THE ALLOCATION OF WATER AND INVESTMENT FUNDS,
Missouri Univ., Columbia; and Department of Agriculture, Washington, D. C.
John A. Kuehn, and Durward Brewer.
Land Economics, Vol. 43, No. 4, pp 456-451, November, 1967. 6 p, 9 ref.

Descriptors: *Recreation, *Decision making, Water allocation (Policy), Investment, Planning, Methodology, Recreation demand, Cost-benefit analysis.
Identifiers: Conflicting recreation demands, Basin planning, Alternatives, Attendance model.

The purposes of this article are to evaluate the lack of a consistent methodology for choosing among various types of water-oriented recreational developments, and to propose some workable solutions. The growing significance of recreation in national planning is discussed. Outdoor recreation is a

multicomponent project; choices must be made between different facilities to serve various recreationists. A particular problem is the conflict between stream and reservoir advocates. The increasing demand for water recreation, the growing importance of recreation in water usage, and the diversity among recreational activities have intensified the problem of allocating water and investment funds. Norms are proposed for efficient utilization of resources. Coordination of the recreational uses of a basin is recommended to satisfy as many of the conflicting demands as possible. The basin is the recommended planning unit. The following methodological standards are endorsed: (1) consideration of all alternative projects and combinations; (2) development of a predictive model to estimate attendance; (3) use of benefit-cost analysis to compare future benefits with present and future costs; and, (4) separation of the planning and decision-making functions from the construction function. (Gossen-Chicago)
W69-08108

A BENEFIT-COST ANALYSIS OF LOCAL WATER SUPPLY,
Louisiana State Univ., Baton Rouge. Dept. of Economics.
W. J. Stober, and L. H. Falk.
Land Economics, Vol. 43, No 3, pp 328-335, August, 1967. 8 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Cost-benefit analysis, *Local governments, Water supply, Municipal water, Industrial water, Cost comparisons, Return to scale, Interest rate, Diseconomies of scale, Cost-benefit ratio.

Local water resource development requires modification of the tools which have been developed to analyze federal expenditures. The paper focuses on the problem of a community faced with a shortage of water for industrial and municipal use. Two alternative actions exist: (1) let industrial users develop their own supplies or reduce water consumption through either more efficient use or a substitution for water; or (2) let the community supply water to industrial and municipal users. The comparison is restricted to project financing by the sale of water. In formula, the cost measurements for a community project and a private project are constructed. Cost comparisons are drawn. A numerical example of the process is given. The benefit-cost ratio will always favor the community project if there are constant returns to scale and both projects are discounted at the same interest rate. This conclusion is a direct consequence of the corporate income tax structure. A lower cost of capital to the community then to corporate water users favors the community project. Increasing returns of scale are advantageous to the community project; diseconomies of scale lower the benefit-cost ratio. (Gossen-Chicago)
W69-08109

IMPACT OF COMMUNITY WATER SYSTEMS IN SMALL TOWNS,
Illinois Univ., Urbana. Water Resources Center.
Walter J. Wills, and Donald D. Osburn.
Research Report No 20, Water Resources Center, University of Illinois at Urbana-Champaign, June 1969, iii+ 16 pp. OWRR Project A-027-ILL.

Descriptors: *Evaluation, Illinois, Project planning water supply, Water users, *Benefits, Indirect benefits.

The primary purpose of this study was to describe the impact the addition of a community water system to a small town would have upon that town and the surrounding communities. The benefits of the system were recognized by the residents and some of the first round impacts were measured. Benefits observed were increases in the number of water using appliances, increases in property values, improved fire protection and sanitary conditions. Several factors need to be considered when planning future water systems as to the calculation of future needs of the system. Changes which can be expected in population and business activity, changes in the number of water using appliances, and other factors all need to be considered when planning for the successful installation and operation of a community water system. Ample quantities of water are available in Illinois, but intelligent planning for increasing needs, careful management of water supply, and improved waste disposal are essential. Rural people are showing increased concern and are taking action to maintain an abundant supply of clear, safe water for the future. (Betchart-Univ of Ill)
W69-08125

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DESALTING,
Office of Saline Water, Washington, D. C.
For primary bibliographic entry see Field 03A.
W69-08044

MARKET STRUCTURE AND THE STABILITY OF INVESTMENT,
Michigan Univ., Ann Arbor, Mich.
F. M. Scherer.
American Economic Review, Vol 59, No 2, pp 72-79, May 1969. 8 p, 1 tab, 8 ref.

Descriptors: *Stability, *Capital investment, *Pricing, Industrial production, Demand, Competition, Profit, Equilibrium, Supply.
Identifiers: *Dynamic stability, Industrial organization, Production capacity, Oligopoly.

This paper reports on an empirical study of the link between market structure and dynamic stability. It seeks to determine whether capital investment expenditures were more stable between 1954 and 1963 in concentrated or in atomistically structured industries. With much of water resource planning subject to fluctuations in investment outlay, the model derived here may be used by the water resource planner. The study found investment outlays to be more unstable relative to their trend values in atomistically structured industries. This greater instability was thought to be more the result of low decision-making power dispersion than excessive sensitivity to demand stimuli. (Murphy-Rutgers)
W69-08064

INVESTMENT AND THE FRUSTRATIONS OF ECONOMETRICIANS,
Northwestern Univ., Evanston, Ill.
Robert Eisner.
American Economic Review, Vol 59, No 2, pp 50-64, May 1969. 15 p, 7 tab, 14 ref.

Descriptors: *Resource development, *Technology, *Investment, Planning, Regression analysis, Time series analysis, Costs, Profit, Depreciation.
Identifiers: Econometrics, Theoretical relation, Cross-sectional data, Complications, Simplifications.

The econometrician interested in estimating an investment function is faced with several problems. After determining what relation he wishes to estimate he must question what measured proxies to use for the variables of the theoretical relation. At the root of the difficulty is the fact that investment is forward looking, dependent upon a relation between initial conditions and expectations of the future about which both the investment decision-maker and his econometrician are frequently ill-informed. Estimation is further complicated with the recognition that competition is not perfect. The author considers many other complications which hinder the econometrician in his task. In order to circumvent this situation one would like to simplify; however, it is not at all clear that simplification preserves the essentials of the investment relationship. The author examines some of the difficulties in his own investigation in order to show limitations in this type of analysis. The author concludes that it is a tricky business designing a precise investment relation from ex post variables which fit more or less remotely the usually expectational variables of our true investment relation. It seems highly probable that the relations in the variables we measure are unstable. As such, we might expect similar problems when estimating an investment function for water related projects. (Loeb-Rutgers)
W69-08065

RESEARCH AND DEVELOPMENT, PRODUCTION FUNCTIONS, AND RATES OF RETURN,
University of Southern California, Los Angeles, Calif.
Jora R. Minasian.
American Economic Review, Vol 59, No 2, pp 80-85, May 1969. 6 p, 2 tab, 1 append.

Descriptors: *Technology, Resource development, Return, Regression analysis, Appreciation, Capital, Labor, Benefits, Prices, Profit.
Identifiers: *Production function, *Rates of return, Cobb-Douglas production function, Covariance model, Knowledge, Elasticity, Social return.

This paper reports the results of a study of 'rate of return' to research and development expenditures in a production function setting. Although the tenuous nature of the Cobb-Douglas type of production function was originally indicated by two independent studies in the early 1960's because of its predominance in use, the estimates are obtained by both a covariance model and by the use of a production function of the Cobb-Douglas type. The elasticity of capital and research and development are found to be respectively 0.16 and 0.11. The gross return on investment in research and development is found to be 54 percent as compared with 9 percent for capital. The estimates obtained reflect both successes and failures of research and development projects. To the extent that increased productivity, caused by research and development, is partially passed on to consumers via lower prices for goods, the author's estimate tends to reflect social returns. Water researchers could similarly use production functions in an attempt to estimate rates of return on expenditures for research and development in this area. (Loeb-Rutgers)
W69-08066

EFFECTS OF TAXATION ON RISK-TAKING,
York Univ. (England).
Aiko N. Shibata.
American Economic Review, Vol 59, No 2, pp 553-561, May 1969. 9 p, 2 fig, 9 ref.

Descriptors: *Risks, *Taxes, Investment, Returns, Industrial production, Capital, Labor.
Identifiers: *Risk-taking, Sales tax, Capital allocation, Consumption, Production function.

The author examines the effects of the general sales tax on the distribution of the economy's total capital between risky and sure industries. Few studies exist which analyze the relationships between the changes in the investors' choice and the changes in allocation of real capital among different risk ventures. This paper represents an attempt to construct a new model capable of analyzing the allocation processes of real capital among industrial sectors with different degrees of risk, assuming that the investors evaluate the investment returns in terms of the means and standard deviations. Having constructed such a model, the paper analyzes the effects of the general sales tax on the distribution of real capital among different industries. The study concludes that the general sales tax causes a shift of real capital out of sure industries into risky industries. Water projects are a good example of ventures with different degrees of risk and where a model capable of analyzing the allocation process of real capital among sectors with different degrees of risk would be quite useful. (Loeb-Rutgers)
W69-08068

GOVERNMENT INVESTMENTS IN MACRO-ECONOMIC PRODUCTION FUNCTIONS (GERMAN),
Walter Wittmann.
Kyklos, Vol 22, Fasc 2, pp 297-313, 1969. 17 p, 1 tab.

Descriptors: Investment, Capital, Capital supply, Time lag, Regression analysis.
Identifiers: *Macro-economics, *Production function, Government investment, Cobb-Douglas production function, Public capital stock, Tertiary capital stock.

The author introduces the government investments into a modified Cobb-Douglas production function. These government investments and the corresponding outlays of the private sector of the economy are divided into a public capital stock and a tertiary capital stock. These stocks are introduced into the production function in addition to labor and the private capital stock. Different time-lags between the income-effect and the capacity-effect are considered. In order to cope with the problems arising from the use of regression analysis, empirical investigations generally use the production function in the linearized form, for which the rates of increases are calculated. At the same time the problem of how to find realistic statistical weights arises for the new explaining variables. The author proposes two methods and calculates one example. A discussion of some empirical problems is presented. Economic data from water projects are often fitted to the form of a production function. The Cobb-Douglas production and the CES production function are the forms often used in this sort of analysis and accordingly this article has relevance to empirical studies of water supply and production phenomena. (Loeb-Rutgers)
W69-08070

MARKET ALLOCATION AND OPTIMUM GROWTH,
Chicago Univ., Ill.
H. Uzawa.
Australian Economic Papers, Vol 7, No 10, pp 17-27, June 1968. 11 p, 3 fig, 9 ref.

Descriptors: *Optimization, *Resource allocation, Planning, Consumption, Investment, Capital, Welfare economics, Mathematical model, Taxes, Equilibrium, Income, Production, Prices, Economics, Resources.
Identifiers: *Economic growth, Market mechanism, Securities, Capital accumulation.

The paper compares the relationships of the growth pattern achieved under the market mechanism versus those of optimum growth with the purpose of bringing about optimal allocation of resources over time. Thus, water resource planning could make use of this theoretical resource allocation discussion. The Solow-Swan growth model is used to show that the level of consumption in a market economy is lower than the optimum level and that the rate of capital accumulation determined in the competitive market is higher than the rate which would have been required to achieve optimum growth when the aggregate capital-labor ratio is larger than the long-run stationary ratio. One of the basic techniques applied is a mathematical reformulation of the Irving Fisher theory of time preference along the lines extended by T. C. Koopmans in a number of recent papers. (Murphy-Rutgers)
W69-08071

PUBLIC GOODS IN THEORY AND PRACTICE: A NOTE ON THE MINASIAN--SAMUELSON DISCUSSION,
Virginia Univ., Charlottesville.
James M. Buchanan.
Jour of Law and Econ Vol 10, pp 193-197, Oct 1967. 5 p.

Descriptors: Marginal costs, Monopoly, Discriminatory pricing.
Identifiers: *Public good, *TV Signal, *Tax-financed, *User charge, Pareto optimality, Marginal evaluation, Tax-price, Joint supply, Consumers' surplus.

Minasian is correct when he states that the modern theory of public goods does not allow us to make institutional decisions about organizational alternatives independently of other considerations. Only the most naive of the theory's advocates should have made this claim although some scholars seem to have interpreted it in this sense. Minasian extends his criticism beyond acceptable limits when he suggests that the allocative norms contained within the theory are incorrect within properly constrained models. His demonstration that other considerations may be dominant in certain real-world circumstances has little relevance to the validity or invalidity of the theory of public goods. It is unfortunate that Minasian failed to separate more fully the theory of public goods from the organizational problems in the TV case. It is equally unfortunate that Samuelson chose to keep the discussion on the same ground. Finally, it is distressing that Samuelson, who could have had the better of the argument, threw his own advantage away by bringing idealogical overtones into what should be a reasoned debate. Water resources are generally acknowledged to contain a public goods aspect and as such this article has relevance to theoretical investigations of the public good nature of water supplies and resources. (Sokoloff-Rutgers)
W69-08075

INVESTMENT DECISION UNDER UNCERTAINTY: CHOICE-THEORETIC APPROACHES,
California Univ., Los Angeles.
Jack Hirshleifer.
Quart Jour Econ, Vol 79, No 4, pp 509-536, Nov 1965. 28 p, 10 fig.

Descriptors: *Investment, interest rate, Probability, Variability, Debt.
Identifiers: *Choice-theoretic system, *Time-preference function, *Risk aversion, *Portfolios, *Marginal utility of income, *Asset-preference approach, equity.

The object of this paper is to develop, and show some of the implications of a treatment of risk or uncertain choice that is a generalization of Fisher's theory of riskless choice over time. It provides an interpretation of Fisher's theory designed (a) to examine its character as a model of choice-theoretic structure, and (b) to introduce the firm as a decision-making unit, which Fisher treated only as atomic individuals. Alternative lines of approach to the theory of risky choice are reviewed, showing how they diverge in specification of the choice-objects of individuals. This is followed by important analytical sections, which develop a theory of uncertain choice over time in terms of comparisons between consumption possibilities in different possible dated contingencies or 'states of the world.' This has some relevance for investment decisions in water resources development projects. (Sokoloff-Rutgers)
W69-08095

THE EFFECTS OF MONETARY POLICY ON EXPENDITURES IN SPECIFIC SECTORS OF THE ECONOMY,
Federal Reserve System, New York.
Sherman J. Maisel.
Journal of Political Economy Vol 76, No 4, Part 11, pp 796-814, July/August 1968, 19 p, 6 tab, 1 fig, 4 ref.

Descriptors: *Gross national product, *Investment, Interest rate, Expenditures, Expansion, Growth rate, Financing, Construction, Mathematical models, Supply, Demand, Industrial production.
Identifiers: *Monetary policy, Credit, Consumption, Housing.

The article tests the different monetary theories against available data from 1961 to the present. Monetary policy appears to influence the economy primarily through its impact on spending in particular sectors. The lags between changes in credit and shifts in spending were found to be considerable, although varying among sectors and effected by expectation. Legal and institutional factors cause the distribution of credit among the spending sectors to alter as supply and demand shift with effects as great and greater than the availability and price of credit. The analysis confirmed that higher interest rates brought contraction in investment. The declines reduced the rate of expansion of income and hence the rate of expansion of consumption. Thus, the economy's demand was held within the potential rate of expansion of real output. Due to its dependence on the supply of investment funds, water resource planners are often effected by monetary policy and this article should prove useful. (Murphy-Rutgers)
W69-08096

ON MODELS OF COMMERCIAL FISHING,
Massachusetts Univ., Amherst.
Vernon L. Smith.
Jour Pol Econ, Vol 77, No 2, pp 181-198. March/April 1969. 18 p, 10 fig, 12 ref.

Descriptors: *Commercial fishing, Operating costs, Marginal costs, Competition.
Identifiers: *External diseconomies, *Resource stock externalities, *Mesh externalities, *Crowding externalities, *Quadratic equation, Social cost.

In current fishing theory net return is expressed as a function either of effort or of number of fisherman (K). Most authors assume constant long-run cost per fisherman, so that cost is proportional to effort or (K). Also, fish price is usually assumed to be constant, so that total revenue simply follows the inverted U-shaped sustainable yield curve. The sole owner expands exploitation up to the point where net revenue is at a maximum. Under decentralized, unregulated exploitation, the equilibrium effort or (K) is at the point where all the rent of the fishery is absorbed in cost. This theory is able to account for the situation in which it is not commercially feasible to exploit a fishery; however, it is not able to handle the situation in which a species may be depleted to the point of extinction. This is one of the more serious deficiencies in the received doctrine. In addition, the standard analysis does not provide a dynamic theory; it is not explicit about the various types of externalities that may arise; nor does it explicitly distinguish the effect of such variables as vessel catch rate, fish population mass, investment, and mesh sizes. Many of these criticisms about the need for a dynamic theory, inclusion of externalities, and other closely related variables could be applied to some models of water pricing. (Sokoloff-Rutgers)
W69-08098

A LEGAL-ECONOMIC ANALYSIS OF ADMINISTRATIVE AND MARKET PROCEDURES USED IN THE TRANSFER OF WATER RIGHTS,
Nebraska Univ., Lincoln. Dept. of Agricultural Economics.
Loyd K. Fischer, Maurice Baker, and Clayton Yeutter.
Nebraska Water Resources Research Institute, Technical Research Project Completion Report. 9 p, 2 ref. OWRR Project A-008-NEB.

Descriptors: *Water rights, *Transfers, *Administration, *Economics, *Costs, Water pollution control, Water supply.

A comparative study of selected states' water laws and their administration resulted in the recommendation of the pyramidal institutional structure. A state water resources board would develop a comprehensive state water plan, gather hydrologic data, reserve water rights on behalf of the public, provide leadership in solving state-wide problems and coordinate local administration. This would in-

clude delineation of geographic boundaries of local water districts. The local districts--streamflow, groundwater and combined--would be autonomous except for coordination between districts. This coordination would be provided by the water resources board. Within this administrative framework, a market for water rights could exist. External or spillover effects could be handled with this type of institutional arrangement. Meat packing plants in the midlands are generally giving primary treatment to waste waters. All of the plants contacted, which have been built within the last ten years are treating wastes before discharge. Reuse of water is not practiced to a great extent by the plants. Total water costs varied between plants from slightly over one cent to nearly seven cents per hundredweight of processed carcass. In no case, was the estimated costs associated with water supply and waste treatment greater than two percent of the total operating costs of the plant.
W69-08115

6D. Water Demand

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO A STUDY OF WATER RESOURCES MANAGEMENT,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
Eugene K. Israelsen, and Paul J. Riley.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 49-58, 1968. 10 p, 8 fig.

Descriptors: *Analog models, *River basin development, *Water management (Applied), *Utah, Evapotranspiration, Infiltration, Recharge, Discharge (Water), Inter-basin transfers, Surface-groundwater relationships, Conjunctive use, Water rights.
Identifiers: *Weber Basin (Utah), Provo Basin (Utah).

The feasibility of water export from the Weber Basin, Utah has been contemplated for many years. The problem was to establish in-basin water requirements, probable excess amounts, possible intrabasin and interbasin water exchanges, and necessary storage to obtain efficient use of water all within the framework of current water rights. The dynamic flow system of the Weber River Basin was modeled for testing and evaluation on the analog computer. Once the model was verified, design values of the basic hydrologic inputs and specific development alternatives were introduced to estimate the water excess amounts in the upper basin that can be exported, storage capacity required to facilitate maximum export with the existing system, the proportions of new and reclaimed water needed in the lower portion of the Basin to satisfy municipal and agricultural requirements, and whether a transfer of water from the lower Bear River Basin to the lower Weber Basin might allow an increase of export to the Provo Basin. The results of this study show some of the possible solutions to the problem of efficient use of water through interbasin and intrabasin trade. (Knapp-USGS)
W69-07745

WATER AND CHOICE IN THE COLORADO BASIN,
National Academy of Sciences, Washington, D. C.
Gilbert White.
Civil Eng, Vol 39, No 6, pp 80-82, June 1969. 3 p, 1 fig.

Descriptors: *Water management (Applied), *Arizona, *Colorado River Basin, *Irrigation water, *Reviews, Decision making, Public rights, Political aspects, Cost-benefit analysis, Economics, Jurisdiction, Water resources development, Optimization, Non-structural alternatives.
Identifiers: *Central Arizona Project.

When an area is confronted with a water shortage, supplying more water may not always be the best solution. And in determining what is indeed the best solution, a considerably broader range of alternatives should be considered than has been the practice, for example, in Central Arizona. However, to do an intelligent job of considering more alternatives 2 steps must be taken: (1) Research must be undertaken in a wide range of technical and non-technical matters to provide the basis for establishing alternatives and choosing among them. (2) The choice from among the most promising alternatives should be made not by technical specialists alone, but in close consultation with the public in the area affected (and who will be asked to pay the bills). The specialists should see the public as an ally, not an adversary; for one thing, the public can change the parameters of public acceptability or dollar limitations, and for another, only it can meaningfully weigh the unquantifiable factors such as the value of esthetics and of preserving unique resources. (Knapp-USGS)
W69-07925

FUTURE WATER SUPPLY-FACILITIES, METROPOLITAN WASHINGTON REGION,
Metropolitan Washington Council of Governments, D. C. Board of Engineers.
For primary bibliographic entry see Field 06B.
W69-08024

WATER REQUIREMENTS AND USES IN ARIZONA MINERAL INDUSTRIES,
Bureau of Mines, Denver, Colo. Div. of Mineral Resources.
For primary bibliographic entry see Field 03E.
W69-08058

THE USE OF MODERN SYNTHESIS METHODS FOR THE QUANTITATIVE ESTIMATION OF WATER RESOURCES,
A. Le Saget and P. Prudhomme.
International Conference on Water for Peace, Vol 6, U S Government Printing Office, Washington, D C, pp 436-443, 1968. 8 p

Descriptors: *Underground storage, *Water quality, *Water resources, *Permeability, Piezometers.
Identifiers: *Simulator studies, *Optimum aquifer exploitation, Resource estimation, Rheoelectric tank, Quantitative data, Differential equations, Paris Metropolitan Area.

It was not until water needs increased past the limit of existing reserves that man became aware of the necessity of making optimum use of water resources. This led to the notion of overall resource estimation of the aquifer and basin. However, this notion must not limit itself to static in situ resource estimation; it must also include optimum storage condition determination so that the effects of feed fluctuations can be reduced. Based on this concept, the study of aquifers must go further than the mere determination of their workable reserves; it must define the respective characteristics of the aquifers in view of their optimum exploitation on a regional scale so that fluctuating resources can be adapted to varying needs. To do this, the sole qualitative description of phenomena is not enough; it becomes necessary to call upon precise quantitative methods capable not only of defining in situ reserves, but also of forecasting aquifer evolution as a function of their exploitation and feed variations. This paper attempts to show how these quantitative methods are used to achieve optimum aquifer exploitation and to define and illustrate how they should be used. (Sokoloff-Rutgers)
W69-08073

ARE WESTERN RECREATION RESOURCES ADEQUATE TO MEET NATIONAL AND REGIONAL DEMANDS,
Colorado State Univ., Fort Collins.
Stewart G. Case.
Resources Development: Frontiers for Research, pp 279-286, University of Colorado Press, Boulder, 1960. 8 p, 13 ref.

Descriptors: *Recreation, *Recreation demand, Recreation facilities, Population, Income, Labor mobility, Resources.
Identifiers: *Recreation resources, National demand, Regional demands, City growth, Leisure time.

The author considers factors necessary to be investigated before any decision or conclusion can be made with respect to our future needs of recreation resources. Among the most important of these are population trends, growth of urban areas, increase in leisure time, higher incomes, greater mobility, and an inventory of our resources and facilities. As for population, birth rates are difficult to estimate but it is obvious that there is going to be an increase in the number of potential user of recreation areas. As the population of the United States has increased, the average size of cities has risen from about 8,000 persons in the late eighteenth century to over 20,000 in the middle of the twentieth century. Average density in centers of population has increased by more than fifty percent. There is an increasing amount of leisure time enjoyed by almost everybody as well as an increase in real income. As such, one would expect per capita expenditures on recreation to continue to rise. The new developments in transportation will lead to increased use of recreation areas. Many of the facilities constructed during the 1930's, however, have less capacity now then they did earlier. The author concludes that the Western recreation resources are adequate to meet national and regional demands because of our rapid technological changes. Since water is an important component in outdoor recreation this article has relevance to investigation into water oriented recreation problems. (See also W69-08088). (Loeb-Rutgers)
W69-08092

WATER 'REQUIREMENTS': THE INVESTMENT DECISION IN THE WATER SUPPLY INDUSTRY,
Manchester Univ., (England).
J. J. Warford.
The Manchester School of Econ and Soc Studies, Vol 34, No 1, pp 87-112, Jan 1966. 26 p, 5 fig, 1 append.

Descriptors: *Water requirements, *Water supply, Cost-benefit analysis, Water demand, Prices, Elasticity of demand, Benefits, Marginal costs.
Identifiers: *Investment decisions, *North West England, *Metered consumption, Average cost pricing, Social rate of discount, Capacity, Substitutes, Externality.

Consideration of a scheme such as the Morecambe Bay Barrage, which will yield large quantities of water (estimates vary from 200 to 400 mgd) and involve a highly initial outlay (estimated at pounds 40 million, which does not include the cost of building aqueducts to the consuming areas) requires at least some notion of the value that consumers will place on the water provided. Given present pricing arrangements this information is hardly likely to be forthcoming, but without it, although we are able to choose between alternative investments in water supply, we have no grounds on which to weigh the benefits of investment in water supply against the benefits of any other form of expenditure. As provision of extra supplies becomes more costly, and as water becomes used for less and less necessary purposes, the 'requirements' concept may no longer be sufficient; more sophisticated techniques of assessing the relative costs and benefits of water supply projects are now appropriate to match scientific and engineering advances in the industry. The view that 'water is cheap at any price' is almost certain to lead to over-investment in water supply projects. (Sokoloff-Rutgers)
W69-08097

6E. Water Law and Institutions

LEASEHOLD INTERESTS IN EMINENT DOMAIN,
Oklahoma State Dept. of Highways, Oklahoma City.

Floyd Taylor, and John Paul Walters.
Highw Res Rec, No 258, pp 8-21, 1968. 14 p, 90 ref.

Descriptors: *Leases, Rent, *Eminent domain, *Condemnation, Pricing, Right-of-way, Legal aspects, Real property, Property values, Land tenure, Value, *Land appraisal, Evaluation, Legislation, Bibliographies, Appraisals, Land ownership.
Identifiers: Land acquisition.

Condemning leasehold estates involves problems not present in condemning properties where ownership is unencumbered. Several states have reached different solutions in dispensing so-called just compensation. In some situations, immediate equities take precedence over logic and reason in arriving at just compensation. hopefully, in most applications, reason and logic, and immediate equities coincide with a finding of just compensation. Just compensation involves balancing reason and equity in determining the relative rights of the landowner and public. The right to jury trial in eminent domain cases is the most effective method of ensuring the precedence of immediate equities over cold logic and reason in finalizing the rights of the parties. Of course, the jury cannot stray far outside the bounds of logic and reason in applying a layman's sense of justice to a particular rule of compensability. Juries can rectify inequitable results of strict applications of rules of noncompensability not meeting expectations of the lay-legal conscience. Yet, the question remains as to whether this is fair to the condemning public. Hopefully, a jury's verdict will lie somewhere in the gray area between the layman's conscience and the legally defined rights of the public. (USBR)
W69-07814

INSTITUTIONAL CONSTRAINTS ON THE DEVELOPMENT OF A REGIONAL WATER SUPPLY SYSTEM: THE CASE OF DETROIT,
For primary bibliographic entry see Field 06B.
W69-07871

WATER RESOURCE DEVELOPMENT IN CALIFORNIA: THE COMPARATIVE EFFICIENCY OF LOCAL, STATE, AND FEDERAL AGENCIES,
Resources for the Future, Inc., Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-07873

STATE REFORESTATION PROJECTS.

Minn Stat Ann secs 84A.31 to 84A.42 (1947).

Descriptors: *Minnesota, *Forests, *Reforestation, *Conservation, Forest fires, Lakes, Streams, Wildlife, Fishing, Wildlife conservation, Management, Regulation, Local governments, State governments, Taxes, Eminent domain, Land, Ditches, Drains, Financing, Projects, Administrative agencies, Legislation, Legal aspects, Supervisory control (Powers).
Identifiers: Afforestation.

For the purpose of vesting the state with title to land suitable for the development of forests and fire prevention, for advancing afforestation and reforestation, for controlling and regulating lakes and streams, and for creating game and fish reserves, the county commissioners of any county in which such lands are situated, and upon which certain taxes are delinquent, may propose that the state take over the land as a forest project. Each such project shall be under the control of the Department of Conservation which shall make rules and regulations for the care of the forests, streams and lakes, wildlife and land. The county auditor shall certify any such land to the state auditor who shall pay the delinquent tax to the county, and the land shall be transferred to and held by the state in fee. The state shall have the right of eminent domain over any provate land within any project. (Helwig-Fla)
W69-07878

COMPLIANCE WITH ARTICLE SUSPENDED WHERE REQUIRED EQUIPMENT UNOBTAINABLE; ALLOWANCE FOR PLANNING AND INSTITUTING CHANGES.

W Va Code Ann sec 22-2-76 (1966).

Descriptors: *West Virginia, *Legislation, *Coal mines, Drilling equipment, Earth handling equipment, Electrical equipment.
Identifiers: Rock-dusting machines, Flame safety lamps.

Whenever any equipment or supplies required by this article, including rock-dusting machines, flame safety lamps, and permissible electric equipment, are unobtainable in the normal course of business, compliance with the requirements of this article with respect thereto is suspended so long as such items remain unobtainable. Due allowance shall also be made for planning, institution of change procedures, and installation of new equipment. (Carruthers-Fla)
W69-07879

WILLIAMS V STATE (FLOOD DAMAGE FROM OVERFLOWING STORM SEWERS).

74 NYS 2d 647-653 (N Y Ct Cl 1947).

Descriptors: *New York, *Storm drains, *Surface runoff, *Flooding, Surface waters, Stormflow, Flood damage, Overflow, Sewers, Drainage water, State governments, Concrete pipes, Storms, Cities, Channel flow, Diversion, Alteration of flow, Manholes, Natural flow, Regulated flow, Rainfall, Judicial decisions, Legal aspects, Rainfall intensity.
Identifiers: *Act of God, Catch basins.

Plaintiff brought action against the state to recover for flood damages to his building caused by the overflowing of state-owned storm sewers alleged to have been negligently constructed and maintained. Defendant asserted that on the dates in question, there was a rainfall of unprecedented severity that could not reasonably have been anticipated and that it was such as to be deemed in law an act of God. The court held that the rainfalls were not of unprecedented severity and could not be urged by defendant as an act of God to defeat plaintiff's claim. Furthermore, from the evidence, the court was of the opinion that the storm sewers were not properly constructed and maintained and that this constituted negligence which proximately caused the overflowing of plaintiff's property. A city is not liable for an increase in flow of surface waters resulting solely from the pavement of streets, but where it collects surface water into a single channel and casts it into a stream, filling it beyond its natural capacity, and flooding an adjacent owner's land, the city is liable. The court concluded that plaintiff was entitled to recover damages. (Reed-Fla)
W69-07880

IMPROVEMENT, STORAGE AND SEWAGE DISPOSAL DISTRICTS IN NEW YORK.

N Y Town Law secs 190, 190a, 190b, 190c, 190d (McKinney 1965), as amended, (McKinney Supp 1968).

Descriptors: *New York, *Legislation, *Regulation, *Local governments, Cities, Administrative agencies, Water districts, Public utility districts, Hydraulic structures, Docks, Navigable waters, Water supply, Reservoirs, Sanitary engineering, Sewage disposal, Sewers, Sewage treatment, Legal aspects.
Identifiers: Statute.

The town board, upon proper petition, may establish or extend improvement districts including water supply and sewage treatment districts. A town may establish a public dock district or beach erosion control district pertaining to any navigable waters within the town's jurisdiction. However, a water supply district may not be established or extended so as to include lands situated in another water district. Water storage districts and water distribution districts may also be established by the town board. A sewage disposal district shall consist of sewer districts which need not be contiguous. Establishment of the forgoing districts is to be preceded by public hearing, notice of which is to be published by the board. At any time within sixty days after the board has acted on a request to establish such a district, a petition requesting a referendum may be filed. All petitions under this statute will be sufficient if signed by twenty-five real property owners within the affected district. (Katz-Fla)
W69-07881

GENERAL PROVISIONS AND FISHING REGULATIONS.

Del Code Ann tit 7, secs 901-917 (1953), as amended, (Supp 1966).

Descriptors: *Delaware, *New Jersey, *Delaware River, *Fish management, Interstate compacts, Regulation, Legislation, Fish conservation, Fishing, Sport fishing, Commercial fishing, Shell fish, Sport fish, Nets, Fyke nets, Gillnets, Fishing gear, Fish harvest, Bait fishing, Recreation.
Identifiers: *Delaware Bay, Penalties.

The provisions herein, affecting only the waters of the Delaware River and Bay lying between Delaware and New Jersey, extend uniform fishing regulations to inhabitants of both states. Game fish may be taken only with rods or hand lines, each having no more than 3 hooks, or artificial bait with no more than 3 hooks. Any type fish, except shell fish, may be taken between the high and low water mark with any net, hook and line or other appliance. Bait fish may be taken with rods, hand lines, minnow seines less than 100 feet long, or dip nets. Food fish may be taken with seines, gill nets, eel pots, parallel nets, or rods and hand lines. The use of stake nets is prohibited except where, by reason of oyster stakes, use of drift nets is possible. Taking of fish by explosives or poison is prohibited. The use of nets is prohibited from 2 p.m. Saturday until 12 o'clock midnight on Sunday. The use of food fish for extracting oil or making fertilizer, and the use of rakes and dredges from July 1st through September 1st south of Mahon's River and west of Blakes's channel, is prohibited. Non residents and aliens may take fish only by use of rods or hand lines. Violations of these provisions are punishable by fine and/or imprisonment. The terms 'game fish,' 'bait fish', and 'food fish' are defined. (Kahle-Fla)
W69-07882

DAMS AND LAKE WATER LEVELS.

Minn Stat Ann secs 110.121 to 110.22, 110.31 to 110.40, 110.46 to 110.53 (1967).

Descriptors: *Minnesota, *Dams, *Flooding, *Bodies of water, Local governments, Conservation, Surveys, Water conservation, Repairing, Maintenance, Legislation, Dam construction, Damsites, Dikes, Flood control, Water supply, Water levels, Lakes, Reservoirs, Cities, Easements, High water mark, Low water mark.
Identifiers: Logging dams, Logging streams, Flowage easements.

The county boards of commissioners are empowered to control and maintain certain water bodies. The boards have authority in mapping, appraising, condemning and developing improvements. For the protection of the natural features of certain waterbodies, limitations on construction and flooding are defined. The policies, limitations, liabilities and rights pertaining to the erection of dams on rivers and streams are provided. Responsibilities for damages from overflow caused by dams are defined and liability established. Regulations pertaining to maintaining water levels in certain bodies of water, the rights of property owners affected by flowage easements and regulations con-

cerning abandonment of dams are given. The general policy covering dams and reservoirs and general operational plans are stated. (Helwig-Fla)
W69-07883

DAMS AND LAKE WATER LEVELS.

Minn Stat Ann secs 110.121 to 110.22 (1967).

Descriptors: *Minnesota, *Dams, *Flooding, *Dam construction, Bodies of water, Local governments, Conservation, Surveys, Water conservation, Legislation, Damsites, Flood control, Water levels, Lakes, Reservoirs, Cities, Easements, Lumbering, Navigable streams.
Identifiers: Logging streams.

The board of county commissioners of any county may improve any waterbody located in the county to enhance navigation or to promote the public welfare. The public shall have access to any waterbody so improved. If a new dam is constructed in connection with the improvement, the board shall have the power to remove any old dam rendered useless. To preserve natural features, no dam shall be built across certain designated waterbodies without special legislation. A dam may be erected across a nonnavigable stream causing the land of others to be overflowed if the land is acquired by the dam owners through the proper legal proceeding. The county board may license anyone desiring to erect a dam for the purpose of sluicing and driving logs and timber. The owner of land bordering on a nonnavigable stream available for floating logs may dam the stream to develop power or to furnish municipal water supplies. However, such dam must be supplied with sluiceways or locks for floating logs around it. (Helwig-Fla)
W69-07884

LAKE WATER LEVELS.

Minn Stat Ann secs 110.31 to 110.40 (1967).

Descriptors: *Minnesota, *Dams, *Littoral, *Easements, Navigation, Recreation, Water levels, Conservation, High water mark, Dam construction, Eminent domain, Riparian owner, Damsites, Legislation, Flood control, Water supply, Lakes, Administrative agencies, Riparian land, Overflow.
Identifiers: Littoral owner, Perpetual flowage easements.

On any lake where: (1) a dam affecting water level shall have existed at the outlet of the lake for at least 15 years; (2) the lake shall have been used for navigation, fishing, hunting or other purposes; (3) other uses of the dam shall have been abandoned; and (4) the continuance of lake level regulation is desirable, it shall be presumed that any littoral owner has dedicated a perpetual flowage easement for all overflow resulting from the operation of such dams. The Commissioner of Conservation may accept a conveyance or release from any owner granting the state a flowage easement on his land. The effect of any easement so obtained by the state may be determined by an action brought in the name of the state in the district court. Every easement obtained on account of any dam shall attach and be appurtenant to such dam and the purposes thereof. Any high water mark established by any dam authorized herein shall supersede the natural high water mark of the waters affected. Any dam not in use for 15 years shall be presumed abandoned. (Helwig-Fla)
W69-07885

WATER CONTROL WORKS AND WATER LEVELS.

Minn Stat Ann secs 110.46 to 110.53 (1967).

Descriptors: *Minnesota, *Dams, *Water control, *Headwaters, Flooding, Flood control, Navigable waters, Conservation, Legislation, Silt, Lakes, Lake beds, Administrative agencies, Projects, Federal government, Water rights, Regulations, Reservoirs, Wildlife, Wild rice, Discharge (Water), Reservoir silting, Mississippi River, Sediment control.
Identifiers: Water control works, Reservoir elevation.

The existing dam and appurtenant water control works on Big Stone Lake, a public navigable waterbody, are inadequate and ineffective to conserve, control, and maintain the waters for public purpose. The works aggravate the deposit of silt on the lake bed. A project plan to remodel and complete said works has been prepared by the Commissioner of Conservation and approved by the South Dakota-Minnesota Boundary Waters Commission. The Commissioner is authorized to construct, maintain and operate said project. The Commissioner is authorized and directed to enter into a cooperative agreement with the United States to control and regulate the reservoirs in the headwaters of the Mississippi River. The purpose of the agreements shall be to regulate the elevation and the discharge of the reservoirs. The plan shall include operation of the reservoir dams so that desirable lake levels are maintained for recreation, with due consideration given to the growing of wild rice, protection of wildlife resources and maintenance of headwater, river uses and water level minimums. The plan shall anticipate abnormal inflow emergencies, navigation requirements and flood control. (Helwig-Fla)
W69-07886

TIDAL WATERS.

Md Ann Code Art 66C secs 262, to 268 (1957), as amended, (Supp 1968).

Descriptors: *Maryland, *Commercial fishing, *Tidal waters, *Nets, Administrative agencies, Legal aspects, Legislation, Water policy, Water law, Fishing, Fishing gear, Commercial fish, Fisheries, Striped bass, Gars, Carp, Sharks, Fish management, Regulation, Reasonable use, Water policy, Equipment, Navigation, Electro-fishing, Permits, Spawning.
Identifiers: Obstruction to navigation.

Only residents and landowners may fish with nets in the tidal waters of the state. It is unlawful to take fish by the use of a gig, purse net, buck net, beam trawl, otter trawl, trammel net, troll net, or drag net except in waters of the Atlantic Ocean. With an appropriate license commercial fishermen may use up to five dip nets, hoop nets, and pound nets for taking finfish. Use of airplanes and electronic devices in tidal waters for locating fish is illegal. As regulated by the Department of Chesapeake Bay Affairs, fishing in certain striped bass spawning areas is illegal. There are a number of regulations governing commercial sale of striped bass. Pound or stake nets are limited in size and may not be used where they will impede or obstruct navigation. It is unlawful to use two or more power vessels to drag a seine and to use a seine in excess of 600 yards in length. There are a number of other restrictions relating to size and use of seines. Bow and arrow is a legal means of taking carp, garfish, bullfish and shark. (Johnson-Fla)
W69-07887

NATURAL RESOURCES INSTITUTE.

Md Ann Code Art 66c secs 18 through 21 (1957).

Descriptors: *Maryland, *Water resources development, *Natural resources, *Schools (Education), Conservation, Legal aspects, Legislation, Water law, Water policy, Social aspects, Administration, Education, Facilities, Fish management, Wildlife management, Surface waters, Governments, Institutions, Planning, Tidal waters, Universities.

The Natural Resources Institute is a part of the University of Maryland and supersedes the Department and Commission of Research and Education. It conducts a comprehensive research and educational program covering the nonagricultural and forestry natural resources of the state. There is emphasis on tidewater and inland resources and organisms, including fish and wildlife, and surface water of the state. It cooperates with all related agencies whether governmental or private. Its staff may collect such animals, plants and other samples and use those collecting devices, seasons, and techniques as are necessary to fulfill its purpose. The Board of Regents of the University of Maryland supervises and controls the institute. The institute's director serves as a member of the Board of Natural Resources and the Water Pollution Control Commission. (Johnson-Fla)
W69-07888

ROADS AND HIGHWAYS.

W Va Code Ann secs 17-17-2, 17-17-4, 17-17-5, 17-17-17, 17-17-25, 17-17-30, 17-17-31 (1966).

Descriptors: *West Virginia, *Bridges, *Bridge construction, *Ohio River, Legislation, Permits, Federal government, State governments, Local governments, Boundaries (Property), Navigable rivers, Nonnavigable waters, Streams, Locks, Contracts, Leases, Navigation, Construction costs, Cost repayment, Loans, Administrative agencies, Administrative regulation.
Identifiers: *Bridge corporations, *Toll bridges, Great Kanawha River, Big Sandy River, Obstructions to navigation, Nuisance (Public), Tolls.

Corporations may be formed to construct bridges across the Ohio, Great Kanawha, and Big Sandy Rivers in the manner provided by the U S Congress. Bridges constructed contrary to the provisions of this statute are deemed nuisances. No bridge shall be constructed so as to obstruct navigation. The state road commissioner may purchase land and construct toll bridges over any river lying wholly or partly within the state or forming a boundary of the state with the proceeds of bridge revenue bonds. No bridge shall be constructed across any river between any bridge and any bridge owned by the state and operated as a toll bridge by the state road commissioner, except under a permit of the commissioner, until a certificate of convenience and necessity is granted by the public service commission. Incorporated cities are authorized to construct toll bridges or tunnels over or under rivers from a point within the city to the opposite shore. Such cities may purchase existing bridges owned by bridge companies or corporations. (Kahle-Fla)
W69-07889

ROADS AND HIGHWAYS.

W Va Code Ann secs 17-17-2, 17-17-4, 17-17-5 (1966).

Descriptors: *West Virginia, *Bridges, *Bridge construction, *Ohio River, Federal government, State governments, Local governments, Locks, Tributaries, Channels, Standards, Navigable rivers, Contracts, Leases, Legislation, Navigation, Bridge design, Engineering structures.
Identifiers: *Nuisance (Public), *Obstruction to navigation, Bridge corporations.

Corporations may be formed and railroad corporations are authorized, to construct toll bridges across the Ohio River in a manner provided by the U S Congress. Real estate may be obtained according to law and purchases made from other bridge corporations. Subscriptions to stocks and bonds may be made by counties, districts, municipalities and other corporations. Corporations may be formed to construct bridges across the Great Kanawha or Big Sandy Rivers in like manner--provided that bridges across the Great Kanawha between the U S government lock number six and lock number three or between lock number three and a point 600 feet below the intersection of the Kanawha and Nancy's branch shall have at least one channel span, the center of which shall be the middle of the channel run by coal fleets. Such span

shall have a clear opening of 400 feet at low water line and be at least 65 feet above low water. Bridges constructed contrary to the provisions of these sections are deemed public nuisances abatable by indictment of bill in equity brought by the attorney general or prosecuting attorney of the proper county. Bridges shall be constructed as not to obstruct navigation of the watercourse at any ordinary stage of water. (Kahle-Fla)
W69-07890

ROADS AND HIGHWAYS.

W Va Code Ann secs 17-17-17, 17-17-25 (1966).

Descriptors: *West Virginia, *Bridges, *Bridge construction, *Permits, Boundaries (Property), Bridge design, Public benefits, Right-of-way, Easements, Legislation, State governments, Navigable rivers, Nonnavigable waters.

The state road commissioner may construct bridges of such design and at such places approved by the state road commission over any river lying wholly or partly within the state or forming a boundary of the state. Such bridges are to be financed with the proceeds of bridge revenue bonds. The commissioner may purchase land, structures, rights-of-way, franchises, easements, and other interests in land deemed necessary for the construction of such bridges. Sections 17-17-13 to 17-17-28 are deemed alternative methods for the doing of things authorized hereby in addition to powers conferred by other laws--provided that no bridge shall be constructed between any bridge and a bridge owned and operated by the state as a toll bridge, except under written permit of the commissioner, until a certificate of convenience and necessity is granted by the public service commission. Application for such a certificate shall contain a map showing the location and design of the bridge to be built, the location of existing bridges between which the bridge is to be built, the location of public roads leading to the existing bridges and any other information deemed necessary. The public service commission before issuing a certificate must by investigation and hearing determine that there is imperative public need for such a bridge and that the revenue from any state owned bridge will not be materially impaired by construction and operation of the bridge. This proviso shall not apply where tolls from the state-owned bridge are used only for maintenance, repair and operation of the bridge. (Kahle-Fla)
W69-07891

ROADS AND HIGHWAYS.
W Va Code Ann secs 17-17-30, 17-17-31 (1966).

Descriptors: *West Virginia, *Bridge construction, *Local governments, Bridges, Construction costs, Cost repayment, Loans, Federal government, State governments, Navigable rivers, Nonnavigable waters, Streams, Regulation, Leases, Contracts.
Identifiers: *Toll bridges, Tolls.

Any incorporated city or county court of any county in which there is a portion of a navigable or nonnavigable river may construct and maintain a toll bridge or tunnel across such river from a point within the city to the opposite side of the river. No bridge may be built contrary to federal regulations or without approval of the state road commission. Bridges may be funded by bonds or from state or federal loans. Any such city or county so situated may purchase, or lease, existing bridges from any bridge company or corporation with funds from the same sources. (Kahle-Fla)
W69-07892

TOWN OF PADEN CITY V FELTON (DRAINAGE DITCH AS EASEMENT).

66 SE 2d 280-297 (W Va 1951).

Descriptors: *West Virginia, *Drainage systems, *Easements, *Surface drainage, Ditches, Judicial decisions, Legal aspects, Cities, Surface waters, Surface runoff, Drainage water, Public rights, Obstruction to flow, Prescriptive rights, Prior appropriation, Competing uses, Relative rights.
Identifiers: Injunction (Prohibitory).

Defendant owned two lots traversed by a drainage ditch carrying surface water runoff from adjacent land and streets. The ditch was cleaned intermittently by the town of Paden City. Defendant obstructed the flow of water in the ditch by accumulating debris therein which allegedly caused flooding, stagnant water, sewer overflow and damage to adjacent sidewalks. Plaintiff town sought to enjoin the interference with the water flow and to abate the alleged nuisance resulting from this obstruction to flow. Plaintiff based its claim alternately on the theories of implied dedication and easement by prescription. The court disagreed on both theories, holding that plaintiff's activities regarding prescriptive rights and rights by dedication were too isolated, sporadic and equivocal to substantiate its claim for relief. The mere use by the public of a private drainage ditch was held not to show a dedication. (Carruthers-Fla)
W69-07893

TOWN OF MEREDITH V STATE BOARD OF HEALTH (STATUTORY POWERS OF THE BOARD OF HEALTH TO ENFORCE REGULATIONS).

48 A 2d 489-496 (N H 1946).

Descriptors: *New Hampshire, *Administrative agencies, *Legislation, *Pollution abatement, Sewage disposal, Pollution identification, Judicial decisions, Water law, Water sources, Public health, Lakes, Ice, Sewage, Administrative decisions, Remedies.
Identifiers: *Injunctions (Prohibitory).

Plaintiff, town of Meridith, bordered on a lake used as a public water supply. Quantities of the town's sewerage flowed into the lake. Defendant, the State Board of Health, pursuant to its statutory authority issued orders and regulations directing plaintiff to install a public system of sewerage. Plaintiff sought to restrain defendant from enforcing these orders. The lower court certified the following questions of law, determinative of the case, to the State Supreme Court: (1) whether the orders and regulations issued by the defendant were within the powers conferred by the statutes; (2) whether the statutes conferring such powers were unconstitutional as a delegation of legislative power; and (3) whether in the exercise of such powers the defendant must comply with the notice requirements of the State's Constitution. Question one was answered affirmatively and two and three negatively. The court held that the statutes adequately provided the defendant with the power to make and compel compliance with the regulations. Furthermore, the broad grants of authority given to the board required expert investigations and findings not normally possible for the legislature to make and hence such powers to make regulations and issue orders is constitutionally delegable. Since Boards of Health act summarily, notice need not be given. (Holt-Fla)
W69-07894

GRAMMAS V COLASURDO (UPPER OWNER MAY ENTER LOWER ESTATE TO CLEAR COMMON DRAINAGE DITCH).

48 N J Super 543, 138 A 2d 553-559 (1958).

Descriptors: *New Jersey, *Prescriptive rights, *Easements, *Natural flow doctrine, Judicial decisions, Water rights, Right-of-way, Drainage, Drainage practices, Ditches, Reasonable use, Obstruction to flow, Relative rights, Natural use, Legal aspects.
Identifiers: Easements by prescription.

Plaintiff sued defendants in trespass, alleging that defendants entered upon his land to widen and deepen a drainage ditch. The defendants, cranberry bog owners, were preparing the ditch to receive the excess waterflow incident to the seasonal drainage of their upland bogs. The defendants claimed alternatively that they had an easement in the plaintiff's portion of the ditch, that they had a legal right to compel the plaintiff to remove any obstructions from the ditch, and that the defendants had a right to enter upon the plaintiff's land to clear the ditch if he refused to clear it. The trial judge refused to offer the above instructions and the jury found for the plaintiff. This court reversed and remanded. All of the defendants' proposed instructions were founded upon the defendants' long use of the ditch to drain their bogs, thus making out an argument for an easement by prescription. The defendants claimed easement would extend to the doing of anything that was reasonably necessary to prepare the ditch for the increased flow. In such circumstances, the upper owner may enter the servient estate to remove obstructions to his right of way as long as there is no breach of peace. (Blunt-Fla)
W69-07895

NELSON V WILSON (SATURATION BY RAISING WATERTABLE CAN CONSTITUTE TAKING OF THE LAND).

58 N W 2d 330-335 (Minn 1953).

Descriptors: *Minnesota, *Dams, *Underflow, *Flood damage, Water injury, Backwater, Judicial decisions, Saturation, Condemnation, Water management (Applied), Water control, Percolation, Soil moisture, Soil texture, Underseepage, Legal aspects, Flooding, Floodwater, Soaking, Eminent domain, Agricultural watersheds.
Identifiers: Action in mandamus.

Plaintiff brought an action in mandamus to compel the commissioner of conservation to condemn and compensate him for lands taken by flooding allegedly caused by the state's water control project. The plaintiff's land was located below the project dam and had been used for agricultural purposes. The land was rendered unsuitable by the flooding, caused by maintaining standing water in a pool at a certain level, at regular intervals after the project was built. The plaintiff also owned land above the dam which allegedly was ruined when the water impoundment saturated the soil and raised the water table. This court affirmed and modified an order compelling the state to condemn the land. The overflowing of land by backing water onto it from dams constitutes a taking of that land. A taking may also occur through underflowing or percolation which raises the water table to the extent that the land is rendered wet enough to impair its agricultural value. Any substantial interference with private property which detroys or lessens its value, or by which the owner's use or enjoyment is substantially abridged is in fact and law a taking to the extent of the damages suffered even though the title and possession of the owner remains undisturbed. (Blunt-Fla)
W69-07896

DAMS IN DISREPAIR; ACQUISITION BY MUNICIPALITY.

N H Rev Stat Ann secs 482:42 thru 482:59 (1968).

Descriptors: *New Hampshire, *Dams, *Repairing, *Eminent domain, Legislation, Maintenance, Operation and maintenance, Investigations, On-site investigations, Cities, Local governments, Compensation, Administrative agencies, Adjudication procedure, Legal aspects, Dam construction, Maintenance costs.
Identifiers: *Dams in disrepair, Water resources board.

The owner of a dam has a duty to maintain and repair such structure. A town or city may petition the water resources board to hold a public hearing

to determine whether a particular dam is in disrepair. The board must give proper notice and may inspect the dam. The board may also initiate a hearing upon its own motion. If the board finds the dam in disrepair, it requires the owner to make the requisite repairs. Should the owner fail to comply, any town in which a portion of the dam is located may petition the board for eminent domain proceedings. After proper notice, the board must hold a public hearing, provided the town's voters have authorized the proceedings. The board shall find what property and rights are reasonably required for the town to construct, maintain, repair, own, and operate the dam so that it will not become a dam in disrepair. If the board shall find that payment to the owner does not exceed the authorized town debt, it shall determine the compensation to be paid and render judgment accordingly. Any aggrieved party may appeal the order of the board. (Breeze-Fla)
W69-07897

STATE RURAL ELECTRIFICATION AUTHORITY ACT (POWER OF AUTHORITY TO MAKE SURVEYS).

S C Code Ann, sec 24-308 (5) (1962).

Descriptors: *South Carolina, *Administrative agencies, *Surveys, Legislation, Economic feasibility, Sounding, Electric power costs, Legal aspects, Project planning, Evaluation.
Identifiers: Rural electric authority, Acquisition.

Subject only to the Constitution of the State, the Authority shall have power to cause surveys to be made of areas throughout the state for the purpose of determining the economic soundness of the acquisition of a system therein, to make plans and estimates of the cost of such system and in connection therewith to enter on any lands, waters, and premises for the purpose of making such surveys, soundings and examinations. (Gadd-Fla)
W69-07898

GROBART V PASSAIC VALLEY WATER COMM'N (CONDEMNATION OF WATER RIGHTS).

51 A 2d 24-27 (N J Ct Err and App 1947).

Descriptors: *New Jersey, *Eminent domain, *Riparian rights, *Condemnation, Compensation, Damages, Rivers, Streams, Riparian land, Legislation, Legal aspects, Water law, Local governments, Judicial decisions, Diversion, State governments, Easements, Prescriptive rights, Administrative agencies.
Identifiers: Adverse use.

Appellant water commission petitioned for a determination of its right to divert 150,000,000 gallons of water per day from locations upstream from respondent's land. Appellant later requested and was granted leave to amend the petition to a diversion of 52,400,000 gallons because it asserted a prescriptive right to divert 22,600,000 gallons through adverse use and a right to 75,000,000 gallons through a contract right obtained from its predecessor in title. Respondent objected to the amendment asserting that appellant had failed to comply with condemnation statutes requiring appellant to obtain the consent of the State Water Policy Commission before condemning the property right. The court held that the statute would not apply to appellant if it could prove its contractual right to divert water. The court found that appellant had failed to so prove. The case was remanded. (Helwig-Fla)
W69-07899

MAINE: BUREAU OF WATERCRAFT REGISTRATION AND SAFETY (COMPREHENSIVE STATUTE REGULATING USE OF POWERED MOTORCRAFT).

38 Me Rev Stat Ann secs 231-241 (1965), 38 Me Rev Stat Ann secs 233, 234, 238, 242, 243, 244, (supp 1968-69).

Descriptors: *Maine, *Boats, *Boating regulations, Administrative agencies, Legislation, Standards, Safety, Recreation permits, Outdoor recreation, Administrative regulation, Water sports, Marinas.
Identifiers: *Power boats.

The State Bureau of Watercraft Registration and Safety is created. The Bureau's purpose is the registration of watercraft and the promotion of safety for persons and property. The bureau is empowered to adopt or amend regulations governing the use and operation of watercraft and safety equipment, including the type, quality and quantity of such equipment. All boats propelled by engines of more than 10 horsepower and all motor boats for hire must have a state certificate and display a registration number. This includes all types of watercraft whether or not engines are their principal source of power. Further provisions detail the methods for displaying identification numbers and provide that failure to produce a certificate on request is prima facie evidence of non-compliance with this article. Certain enumerated classes of motorboats are exempt from the numbering provisions. Certificated owners must notify the state upon the destruction, abandonment, removal, or transfer of ownership of their watercraft. Additional regulations cover boats available for hire. Other sections govern boat operation, regattas, and procedures governing boating accidents. (Blunt-Fla)
W69-07900

MOTOR BOATS, REGISTRATION, EQUIPMENT AND OPERATION.

Del Code Ann tit 23, secs 2111-2130 (Supp 1966).

Descriptors: *Delaware, *Boats, *Boating regulation, *Administrative agencies, Local governments, Legal aspects, Legislation, Boating, Water law, Water policy, State jurisdiction, Permits, Safety, Regulation, Jurisdiction, Marinas.
Identifiers: Negligence, Strict liability.

It is state policy to promote safety for persons and property connected with the use, operation and equipment of vessels and to promote uniformity of laws relating thereto. The Delaware Commission of Shell Fisheries has jurisdiction to coordinate and supervise implementation of this chapter and to issue appropriate regulations. Most boats operating on state waters must be numbered. An annual application to the Commission for such number is necessary. Motor boats fall within one of four classes and the applicable regulations vary according to the classification. Some regulations, such as the requirement of lights after sunset, are consistent throughout each class. The Commission appoints a Boat Safety Director who supervises implementation of the requirements of this chapter. Owners of boat liveries must keep the names and addresses of persons renting vessels and comply with a number of other special regulations. Special regulations apply to boats towing water skiers. Local regulations may not conflict with this chapter. A vessel owner is liable for damages negligently caused by the operator of his vessel. All peace officers of the state are responsible for enforcement of this chapter. (Johnson-Fla)
W69-07901

DRAINAGE.

Md Ann Code Art 66C sec 64 (1957).

Descriptors: *Maryland, *Administrative agencies, *Drainage engineering, *Drainage programs, Legal aspects, Legislation, Water law, Drainage, Drainage practices, Drainage systems, Land management, Local governments, Federal government.

The State Board of Drainage under the control of the State Board of Agriculture is created and is to be administered by the University of Maryland professor of agricultural engineering who is known as the State Drainage Engineer. The duty of said engineer is to promote and encourage drainage of agricultural lands in the state. He is also to correlate the activities of the local drainage organizations in the state and cooperates with state and federal agencies in the interest of a permanent program of improved drainage. (Johnson-Fla)
W69-07902

LOBSTER, TERRAPINS - DIAMOND BACK AND SALT WATER.

Md Ann Code Art 66C secs 335 thru 341 (1957).

Descriptors: *Maryland, *Turtles, *Lobster, *Regulation, Commercial shellfish, Aquatic animals, Nets, Trapping, Wildlife conservation, Commercial fishing, Legislation, Legal aspects, Breeding, Eggs, Confinement pens, Interstate.
Identifiers: *Salt water terrapins, *Diamond back terrapins, Penalties (Criminal), Closed seasons, Limits, Residence requirements, Evidence, Fines, Enforcement.

Possession, sale or transportation of spawning lobster or any lobster less than 3 1/8 inches in length, measured as prescribed, is unlawful. The taking or possession of any salt water or diamond back terrapins, skilpots or sliders from April 1 to October 31 is unlawful. The confinement of terrapins in pens for the purpose of sale or exchange during the closed season is unlawful. However, water pens may be used by dealers or for confinement for propagation purposes. Terrapin under 5 inches long may not be taken or possessed. Except for propagation purposes, the taking, destruction or possession of terrapin eggs is unlawful. No person shall take or catch terrapin mentioned in this section outside the county of his residence. The possession, or confinement of terrapins in a trap, snare, net or other device is conclusive evidence of violation. Terrapin so found may be confiscated. Violations of this section are finable misdemeanors. One half of the fines recovered shall go to any person (other than state officials charged with enforcement) who procures a conviction under this statute. (Harris-Fla)
W69-07903

DREDGING AND BEACHES.

Del Code Ann tit 23, secs 1701-1708 (1953), as amended, (Supp 1966).

Descriptors: *Delaware, *Dredging, *Beaches, *Construction materials, Administrative agencies, Shores, Legislation, Legal aspects, Water law, Water policy, Earth materials, Particle size, Sediments, Silts, Soils, Construction materials, Coasts, Beds, Submerged land, Regulation, Permits, Beds under water, Ownership of beds, Gravels, Construction, Sands.
Identifiers: Penalties (Criminal), Waters of the state.

It is unlawful to take such materials as earth, dirt, mud, soil, and silt, excavated from under the waters of the state, to any point out of the state. Violators may be fined and their boats or vessels are liable for those pecuniary penalties not paid. Sand, clay and other materials used in building or any other art or trade are excluded from these requirements. No sand may be taken from the beaches between Rehobath and the Maryland State Line. Permission of the State Highway Department is necessary for removal of sand from beaches elsewhere. However, persons need not obtain permission to remove gravel found between high and low water marks so long as it is of a variety suitable for concrete masonry. (Johnson-Fla)
W69-07904

DAMS.

Del Code Ann tit 23, secs 1901-1904 (1953), as amended, (Supp 1966).

Descriptors: *Delaware, *Dams, *Mill dams, *Riparian rights, Legislation, Legal aspects, Water law, Regulation, Jurisdiction, State jurisdiction, Permits, Dam construction, Damsites, River regulation, Water control, Bank erosion, Bank stability, Overflow, Riparian land, Riparian water loss, Streams, Washouts, Banks, Boundaries (Property), Floods, Water levels, Eminent domain.

Subject to regulations in this chapter it is legal to build dams across non-navigable waters for working any mill. No dam which would injure any upstream mill site may be built. The Superior Court has jurisdiction to authorize the building of dams in each county. When earth or gravel necessary for construction or repair of any lawful dam lies adjacent to such dam, the owner of such dam may petition to the Superior Court for condemnation of the materials. The value of such materials will be paid over to the property owner and the dam owner will be allowed to use same for the purpose set out in his petition. A dam owner may enter the land of another to repair the banks of any stream where water has been diverted from the customary banks of the stream to the detriment of the stream owner. Damages which may occur due to such entry or repair are assessable against the dam owner. A dam owner is liable for damages caused by waters forced upon the property of others by his dam. (Johnson-Fla)
W69-07905

STORAGE OF NATURAL OR ARTIFICIAL GAS AND PETROLEUM PRODUCTS IN PRINCE GEORGE'S COUNTY.
Md Ann Code Art 66C secs 691, 692 (1957).

Descriptors: *Maryland, *Natural gas, *Underground storage, *Water pollution control, Pollutants, Maps, Permits, Percolating water, Subsurface waters, Underground streams, Administrative agencies, State governments, Legislation, Bodies of water, Wells, Well permits, Drilling, Contamination (Water), Diversion, Withdrawal, Legal aspects, Jurisdiction, Administrative regulation.
Identifiers: Artificial gas, Injunctions (Prohibitory), Injunctions (Mandatory).

The Department of Geology, Mines and Water Resources, shall restrict storage permits for natural or artificial gas as is necessary to protect state waters, including subsurface and percolating waters. Enforcement of restrictions may be sought through injunctive relief in county circuit courts or Superior Court of Baltimore City. Violations shall be finable misdemeanors. Applications for storage permits shall include a competent engineer's or geologist's map showing location, extent and depth of wells and storage places. A copy shall be sent to the Water Pollution Control Commission for advice thereon concerning possible pollution, contamination, diversion or depletion of subsurface or percolating waters. Testimony may also be taken, and the permit granted or denied subject to Water Pollution Control Commission approval. (Harris-Fla)
W69-07906

DEPARTMENT OF CHESAPEAKE BAY AFFAIRS.

Md Ann Code Art 66C secs 6 thru 13L (1957).

Descriptors: *Maryland, *Administrative agencies, *Water management (Applied), *Water resources development, Commercial fishing, Shellfish, Legal aspects, Legislation, Water law, Water policy, Conservation, Fish management, Jurisdiction, Recreation, Regulation, Water conservation, Water utilization, Competing uses, Fish, Tidal waters, Planning, Area development, Economic efficiency, Permits, Mining.
Identifiers: Penalties.

The department of Chesapeake Bay Affairs is responsible for development, management, planning, and conservation of the Chesapeake Bay and all other tidal waters, the operative arm of which is the Commission on Chesapeake Bay Affairs. All matters relating to fish and shellfish and public recreation facilities in the Bay area, except matters under the jurisdiction of the Department of Game and Fish or the Department of Water Resources are within its jurisdiction. The department may also issue licenses and establish fees for certain purposes, regulate the commercial fishing industry, and perform other activities which tend to promote optimal utilization of the state's seafood resources. The mining of raw materials especially gravel, from such waters, the taking of eels, and quarantine of fish are under the control of the department. Judicial review as provided by the Administrative Procedure Act is available for challenging commission decisions. (Johnson-Fla)
W69-07907

LICENSING OF WELL DRILLERS.

Vt Stat Ann tit 10, secs 1151-1157 (Supp 1968).

Descriptors: *Vermont, *Drilling, *Wells, *Water resources, Logging (Recording), Drilling equipment, Underground, Well permits, Well regulation, Legislation, Administration, Administrative agencies, Subsurface waters, Drilling fluids, Water properties, Chemical properties, Physical properties, Control, Regulation.
Identifiers: Permit fees, Renewal.

Any person wishing to engage in the business of drilling wells for underground waters must apply to the state water resources board for a license. There is an annual fee for such license which must be renewed annually. Each driller must keep records on each water well drilled and file that report with the board within sixty days after the well's completion. Refusal to complete the report may result in revocation of the license. No report need be filed if the well is hand driven or dug by other manual means. Within six months of the filing of the report, the driller must file a report of the physical and chemical analysis of a sample of water from each well drilled. A water resources revolving fund is established from which payments may be made for the accumulation of water resources data and information. Any person aggrieved by a decision of the board may appeal to the county court in the county in which he has his principal place of business. (Shevin-Fla)
W69-07908

BLACK BASS AND PIKE, SPEAR FISHING.

Md Ann Code Art 66C secs 314 thru 319B (1957).

Descriptors: *Maryland, *Fish management, *Fishing gear, *Interstate, Pikes, Bass, Fish conservation, Fish stocking, Sea basses, Walleye, Commercial fishing, Fisheries, Regulation, Sport fishing, Legal aspects, Legislation, Water law, Breeding, Creel census, Equipment, Administrative agencies.
Identifiers: *Interstate commerce, *Fish limits, *Fishing seasons, Penalties (Criminal), Creel limit, Spearfishing, Constitutionality.

The catching of pike in tidal waters from March 15 to April 30 is unlawful. Sale, purchase or possession of pike during this period is unlawful regardless of where caught. All black bass except black sea bass, may be caught only with rod and line and are subject tothe creel limit. All netted black bass, except 5 which may be kept for personal use, must be returned unharmed to the water. Except where allowed by this section, sale, purchase, offers to sell or purchase, and possession of black bass is unlawful regardless of where or in what state caught. Nothing in this section prevents interstate shipment of bass for stocking and breeding purposes. Delivery, acceptance for transportation, or transportation of pike or bass into or from Maryland is prohibited except when allowed by this act. Black bass limits are 5 over 9 inches in length. Pike limits are 10 over 14 inches. The taking of wall-eyed pike other than by hook, rod and line, or the actual or attempted purchase, sale, or transportation of them from March 15 to November 30 is prohibited except where allowed by this section. Violations of this section are finable misdemeanors. Unconstitutional portions of this section are severable. Spearfishing is lawful as regulated by the Game and Inland Fish Commission and Department of Chesapeake Bay Affairs. (Harris-Fla)
W69-07909

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.

19 ALR 2d 967-1000 (1951).

Descriptors: *Legislation, *Railroads, *Surface drainage, *Streams, Bridges, Ditches, Culverts, Drains, Roadbanks, Embankments, Dikes, Texas, Indiana, Missouri, Vermont, New York, Damages, Remedies, Surface runoff, Flood damage, Flooding, South Dakota, Natural flow, Obstruction to flow, Diversion, Reasonable use, Relative rights, Legal aspects, Water law.

The manner in which, and the extent to which, the drainage or flow of waters may be affected by the construction and maintenance of railroads has led, in several jurisdictions, to the enactment of statutory regulations on the subject. Prior to the enactment of statutes concerning this subject, such regulations were sometimes included in the corporate charters of railroads. Generally, the statutes either provide for watercourse outlets through or along the roadbed or broadly allude to the requirement that streams crossed by roadbeds shall not be impaired. The scope of this annotation is an analysis of the duties imposed by these statutes and an analysis of what constitutes compliance therewith. The issues of liability and remedies for violation of these statutes are not so included. Questions concerning the use of streams or water and questions of navigability are beyond the scope of the annotation. (Katz-Fla)
W69-07910

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
19 ALR 2d 970-972 (1951).

Descriptors: *Legislation, *Railroads, *Surface drainage, *Streams, Bridges, Ditches, Culverts, Drains, Roadbanks, Embankments, Dikes, Texas, Indiana, Missouri, Vermont, New York, Damages, Remedies, Surface runoff, Flood damage, Flooding, South Dakota, Natural flow, Obstruction to flow, Diversion, Reasonable use, Relative right, Legal aspects, Water law, Precipitation excess.

Arizona requires railroads to restore intersected streams to their former state as nearly as possible so as not to unnecessarily impair their use or injure their franchise. Similarly, Illinois requires railroads to restore intersected streams to the preconstruction status quo. Iowa requires railroads to maintain bridge abutments over streams in good repair. Minnesota requires railroad ditches and culverts to be clean during the period of spring thaw. Missouri requires a railroad to construct and maintain openings through its roadbed. New York requires that intersected streams not be deprived of their former usefulness. Texas, Vermont and South Dakota also base their respective statutes on nonimpairment of former usefulness. Generally, cases construing these statutes have stressed a reasonable interpretation. Statutes requiring a railroad to intersect a stream in such a manner as to afford security to life and property have been held to refer to life and property connected with the stream and not solely that of the railroad. However, a contrary interpretation has been given in construction of a similar Montana statute. (Katz-Fla)
W69-07911

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
19 ALR 2d 972-974 (1951).

Descriptors: *Legislation, *Railroads, *Surface drainage, *Streams, Bridges, Ditches, Culverts, Drains, Roadbanks, Embankments, Dikes, Texas, Indiana, Missouri, Vermont, New York, Damages, Remedies, Surface runoff, Flood damage, Flooding, South Dakota, Natural flow, Obstruction to flow, Diversion, Reasonable use, Relative rights, Riparian lands, Legal aspects, Water law.

The Missouri statute requiring construction and maintenance of drainage facilities requires a railroad to construct and maintain its roadbed so as to prevent injury to adjacent land. Railroads obstructing natural drainage must take steps to prevent the overflow of adjacent land. The contention that the statute only intended to cover cases of standing water which might be injurious to health has been rejected. The Texas statute on right-of-way drainage has been construed to prohibit railroads from interfering with natural drainage on either side of the right-of-way and does not require a railroad to leave excavations on the right-of-way in such condition as to prevent the accumulation of water. It has been held that these general statutes do not otherwise materially restrict the measure of duty otherwise imposed by law on railroads crossing streams. These statutes have been termed as declaratory of the common law duty of care. (Katz-Fla)
W69-07912

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
19 ARL 2d 974-977 (1951).

Descriptors: *Legislation, *Railroads, *Surface drainage, *Streams, Bridges, Ditches, Culverts, Drains, Roadbanks, Embankments, Dikes, Texas, Indiana, Missouri, Vermont, New York, Damages, Remedies, Surface runoff, Flood damage, Flooding, South Dakota, Natural flow, Obstruction to flow, Diversion, Reasonable use, Relative rights, LEGAL ASPECTS, Water law, Riparian lands, Illinois.

The Illinois and Texas statutes requiring railroads to provide drainage along rights of way were enacted prospectively only. The Missouri statute clearly manifests a retroactive intent. The statutory duty of a railroad to provide adequate drainage is generally held to rest on a subsequent purchaser or other successor in ownership of the railroad. Trustees in bankruptcy and receivers are bound by the statutory duty. The Indiana statute provides remedy for adjacent landowners damaged by the railroad's neglect without regard to whether the injured parties were adjacent landowners at the time of construction. Under Missouri law, a railroad's liability for breach of a drainage requirement statute is not limited to adjacent landowners. The Missouri statute has been construed to require only that the railroad maintain adequate drainage culverts to facilitate the movement of water into intersected streams and does not require a railroad to maintain culverts to facilitate movement of water from intersected streams. (Katz-Fla)
W69-07913

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
19 ALR 2d 977-982 (1951).

Descriptors: *Legislation, *Railroads, *Surface drainage, *Streams, Bridges, Dikes, Ditches, Culverts, Drains, Roadbanks, Embankments, Texas, Indiana, Missouri, Vermont, New York, Damages, Remedies, Surface runoff, Flood damage, Flooding, South Dakota, Natural flow, Obstruction to flow, Diversion, Reasonable use, Relative rights, Riparian lands, Legal aspects.

The organization of a drainage district and the levying of an assessment against a railroad does not dispose of its statutory duty to provide drainage facilities. Some general statutes require railroads to maintain openings through roadbeds to connect with ditches, drains or watercourses. Such statutes have been held not to impose a duty to so maintain culverts in the absence of a ditch, drain or watercourse with which connection is possible. A drain, ditch or watercourse does not have to be a running stream to come within the purview of several state statutes to the forgoing effect. Connecting ditches may either be natural or artificial. The statutory duty to provide drainage facilities has been limited, in several cases, to such as are practicable or may be constructed at reasonable cost. (Katz-Fla)
W69-07914

CONSTRUCTION OF STATUTES REQUIRING RAILROADS TO PROVIDE FOR THE DRAINAGE OR FLOW OF WATERS.
19 ALR 2d 982-1000 (1951).

Descriptors: *Legislation, *Railroads, *Surface drainage, *Streams, Bridges, Ditches, Culverts, Drains, Roadbanks, Embankments, Dikes, Texas, Indiana, Missouri, Vermont, New York, Damages, Remedies, Surface runoff, Flood damage, Flooding, South Dakota, Natural flow, Obstruction to flow, Diversion, Reasonable use, Relative rights, Legal aspects, Water law.

Some states impose strict liability on railroads for violation of drainage requirement statutes. However, the majority require a showing of negligence as a condition precedent to liability. Generally, the duty imposed by such statutes is continuing. The statutory duty to restore intersected streams is not limited to navigable streams. Statutes limited to the forgoing restoration have been construed not to impose liability for failure to provide surface water drainage. However, provisions specifically relating to drains, ditches and openings through roadbeds have been interpreted to impose liability for surface water runoff. The construction of bridges, culverts, drains and ditches of adequate size are satisfactory methods of compliance with these statutes. However, construction of such facilities must be in a manner calculated to avoid accumulation of drift or debris. These statutes impose a continuing duty to maintain these facilities. (Katz-Fla)
W69-07915

STATE SHELL-FISHERIES.
Conn Gen Stat Ann secs 26-187 to 26-237 (1960), as amended, (Supp 1968).

Descriptors: *Connecticut, *Shellfish, *Marine fisheries, *State jurisdiction, Legislation, Water law, Legal aspects, Oysters, Clams, Commercial shellfish, Mussels, Ownerships of beds, Boundaries (Property), Jurisdiction, Water rights, Administrative agencies, Local governments, Federal government, Water policy, Invertebrates, Regulation, Adjudication procedure, Boundary disputes.
Identifiers: Penalties (Criminal), Monuments, Markers, Shellfish grounds.

Five commissioners and an engineer constitute the state shell-fisheries commission which has jurisdiction over shell-fish in state waters and is vested with the power to lease certain shell fish grounds. Disputes over boundaries of shell-fish grounds must be taken to the commissioner for settlement. Fees are established for the recording of certain papers and maps including papers which evidence the transfer in ownership of oyster grounds. There is provision for release to the state of oyster grounds, leasing of beacon ground, and buoying of certain natural beds. The enforcement of shell-fish laws, taxation of shell-fish grounds, licensing of oyster vessels, and licensing to work natural beds are duties of the commission. Non-resident oystermen are regulated and there are limitations on the use of power dredges and chain bags. There is provision for designation of shell-fish spawning beds and regulation of mud dumping in waters within the commission's jurisdiction. A license is required for taking conchs and there are certain limitations on digging clams. (Johnson-Fla)
W69-07916

STATE SHELL-FISHERIES.

Conn Gen Stat Ann secs 26-187 to 26-204 (1960), as amended, (Supp 1968).

Descriptors: *Connecticut, *Administrative agencies, *Commercial shellfish, *State jurisdiction, Shellfish, Marine fisheries, Legislation, Water law, Legal aspects, Jurisdiction, Water policy, Regulation, Water resources development, Local governments, Fish management, Ownership of beds, Boundaries (Property), Adjudication procedure, Oysters, Leases, Boundary disputes, Preferences (Water rights), Boundaries (Surface).

An agency of shell-fish commissioners is established and given jurisdiction over all shell fisheries which come under state jurisdiction. Boundary disputes are settled by the Superior Court when there is a conflict between state and local jurisdiction. The commissioners must map natural oyster beds and keep a copy of same available to the public. The commission has the power to lease certain shell-fish areas. Disputes as to ownership of shell-fish grounds are to be settled by the shell-fish commissioners, and surveyors may be hired by the commission to aid in settling these disputes. Appeal of such decisions is available to the superior court. All transfers of title to oyster grounds within state jurisdiction shall be recorded in the office of the shell-fish commission. Owners of grounds designated for oyster cultivation are permitted to release their interests in these grounds to the state under certain conditions. The commission is charged with construction and maintenance of markers of shell-fish grounds within state jurisdiction. Natural oyster beds are distinguished from cultivated beds and the granting of a franchise to take clams or oysters on such beds is illegal. (Johnson-Fla)
W69-07917

STATE SHELL-FISHERIES.
Conn Gen Stat Ann secs 26-205 to 26-216 (1960), as amended, (Supp 1968).

Descriptors: *Connecticut, *Commercial shellfish, *Ownership of beds, *Taxes, Boundaries (Surface), Legislation, Water law, Legal aspects, Clams, Oysters, Shellfish, Regulation, Water policy, Administrative agencies, Water rights, State jurisdiction, Water resources development, Adjudication procedure, Jurisdiction, Financing, Permits, Dredging.

Shell-fish wardens are to be appointed by the commissioners to assist in detecting and prosecuting offenses which violate shell-fish laws. Upon application of the Oysterman's Protective Association of Connecticut or any franchise owner, shell-fish policemen may be commissioned by such association or owner to enforce shell-fish laws. For tax purposes, an owner of a franchise or grounds must deliver a sworn statement of the lot (s) owned by him in order that the value of such property may be determined. The tax rate is two percent of the valuation. Appeal from decisions of the board of tax review may be taken to the court of common pleas. Property may be sold for delinquent taxes or will revert to the state after taxes are in arrears for five years. Oyster boats must be licensed and numbered before any person can take oysters from a natural bed. Each individual upon such a boat is also required to have a license. Owners of boats and crew members must be state residents. Taking of shell-fish by use of power tools is prohibited on natural beds. (Johnson-Fla)
W69-07918

STATE SHELL-FISHERIES.
Conn Gen Stat Ann secs 26-217 to 26-237 (1960), as amended, (Supp 1968).

Descriptors: *Connecticut, *Commercial shellfish, *Administrative agencies, *Regulation, State governments, Local governments, Dredging, Oysters, Shellfish, Permits, Mollusks, Buoys, Spawning, Water law, Legislation, Legal aspects, Inspection, Federal government, Fish management, Preferences (Water rights), State jurisdiction, Ownership of beds, Regulation, Competing uses.
Identifiers: Penalties (Criminal), Mud dumping.

Size requirements are placed on the use of chain bags and net bags. Dredging without a license upon natural oyster beds renders one ineligible for a license for the remainder of the license year. A license is required for taking conchs in excess of five bushels per day. The commission may designate up to ten acre beds as shell-fish spawning areas where taking of shell-fish is prohibited. Mud or refuse dumping may be done by permit only except for work being done by the United States government. Dumping inspectors are to accompany each boat to see that its contents are properly dumped. Depositing starfish, periwinkle, or oysters other than Ostrea Virginica is prohibited. Penalties are provided for unlawfully taking oysters in daytime or at night. Owners are to buoy their shellfish grounds properly. Oysters may not be gathered between July 20 and September 20 from any natural bed. Clams may not be taken by non-residents. No act concerning the quantity of shell-fish to be taken from natural grounds shall apply in certain specified localities. (Johnson-Fla)
W69-07919

WATER RESOURCES AND THE LEGISLATIVE BRANCH,
Subcommittee on Air and Water Pollution (U. S. Congress).
For primary bibliographic entry see Field 05G.
W69-08040

LEGAL ASPECTS OF WATER REUSE IN TEXAS,
Vinson, Elkins, Weems and Searls, Houston, Tex.
For primary bibliographic entry see Field 05G.
W69-08043

THE PRINCIPLE OF 'FISCAL EQUIVALENCE': THE DIVISION OF RESPONSIBILITIES AMONG DIFFERENT LEVELS OF GOVERNMENT,
Maryland Univ., College Park, Md.
J. Olson, Jr.
American Economic Review, Vol 59, No 2, pp 479-487, May 1969. 9 p, 4 ref.

Descriptors: *Optimization, *Government supports, Taxes, Boundaries, Costs, Marginal costs.
Identifiers: *Fiscal equivalence, *Subsidies, Collective goods, Governmental boundaries, Allocative efficiency, Free bargaining.

With most of the functions in the water resource area being performed by government agencies, the attempt by this article to form an economic basis for deciding what type of government should perform those activities that require collective action, should prove useful to the water researcher. The present pattern of governments is duplicative and unsatisfactory. In line with this, the deficiencies of free bargaining among concerned parties in dealing with externalities in a Pareto optimal way, is discussed. A basis for a larger model is then worked out by focusing on the problem of allocative efficiency and the necessary conditions for its existence. This involves a discussion of the beneficial limits of a collective good and the boundaries of the government providing it. The author also studies the influence of economies and diseconomies of scale in the production of collective goods the effect of the scale of government on the optimal mix of governmental institutions. The conclusion warns of some of the dangers of going directly from theory to policy. (Murphy-Rutgers)
W69-08067

LEGAL ASPECTS FOR CONTROL OF INTRASTATE, INTERSTATE AND INTERNATIONAL WATERS,
Michigan State Assistant Attorney General.
Nicholas V. Olds.
The Fresh Water of New York State: Its Conservation and Use, pp 116-123, Wm C Brown Book Co, Dubuque, Iowa, 1967. 8 p, 15 ref. Edited by Lauren B. Hitchcock.

Descriptors: *Legal aspects, *Water control, *Great Lakes, Administration, Harbors, St. Lawrence Seaway, Water management, Federal Government, Boundary disputes, Michigan, Ohio, Lake Erie, Minnesota, Wisconsin, Navigation, Recreation, Water pollution.
Identifiers: Interstate problems, Intrastate problems, International problems, Lake levels, Ownership, Deep draft ocean navigation, International government, Pilotage, Tolls.

The Great Lakes constitutes the greatest body of fresh water in the world and is considered one of the greatest waterways. The basin encompasses eight states, two provinces and two nations. Many intrastate, interstate and international problems of a highly complex nature need to be resolved. In the past there have been boundary disputes settled both by Supreme Court decisions and interstate compacts. The international boundary has been subject to many treaties and is fixed by an International Boundary Commission. Other problems of the Great Lakes, many having economic aspects, concern lake levels, the ownership of natural resources, the construction of ports and harbors, the deepening of channels and the construction of the St. Lawrence Seaway which opened the Great Lakes to deep draft ocean navigation. It is argued that the eight Great Lakes states as well as the two Canadian provinces should play their rightful role in the management and regulation of these water resources in cooperation with federal and international governments and entities. (See W69-08076). (Loeb-Rutgers)
W69-08080

THE COLUMBIA RIVER TREATY, THE ECONOMICS OF AN INTERNATIONAL RIVER BASIN DEVELOPMENT,
Resources for the Future, Inc., Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-08084

WESTERN WATER LAW AND CONFLICTS BETWEEN THE STATES AND THE FEDERAL GOVERNMENT,
Hatfield Chilson.
Resources Development: Frontiers for Research, pp 193-202, University of Colorado Press, Boulder, 1960. 10 p. Edited by Franklin S. Pollak.

Descriptors: *Water law, Control, Water resources, Water supply, Federal Government, Desert Land Act.
Identifiers: *Western water law, *Conflicts. *Doctrine of appropriation, State control, Western States, Pelton Dam case, U S Supreme Court, Nebraska v Wyoming.

This paper deals with the water resource originating in the area of the United States lying west of the 98th meridian, commonly referred to as the Western States. Except in areas such as the Pacific Northwest, the Western States are arid or semiarid, the water supply scarce and therefore extremely valuable. Consequently, competition for the use of the limited water supply began with the settlement of the West and continues at an accelerated pace. This competition has led to innumerable controversies and conflicts among water users, and as a result there has developed in the Western States, over a period of more than one hundred years, a body of constitutional provisions, statutues, and court decisions governing water, its use and disposition. This body of law constitutes what is known as Western water law, and the backbone of this law is the doctrine of appropriation, which is discussed in detail. (See also W69-08088). (Loeb-Rutgers)
W69-08090

DESIRABLE REVISIONS OF WESTERN WATER LAW,
Wyoming Univ., Laramie.
Frank J. Trelease.
Resources Development: Frontiers for Research, pp 203-216, University of Colorado Press, Boulder, 1960. 14 p, 15 ref.

Descriptors: *Water law, Economics water supply, Colorado, Wyoming, Texas, Montana, Water rights, Groundwater, Risks.
Identifiers: *Western water law, Private rights, West, Rightful claimant, Records, Tenure, Semipublic districts, Public interest, Permit system.

The theme for this paper was that economics should play a larger part in water allocation. One of the author's basic criteria was that any law advocated must be a law that has worked in some area. The author contends that the greatest need for water law research is not in the cases and statute books, but in the administrative offices and in the field. Studies of the specific problems of specific basins are needed to give us case reports of a sort other than the results of litigation. If economics is to play an important part in the law, perhaps lawyers should study economics and economists should study law. An important step in this direction, and in the direction of specific studies of particular basins, has been undertaken by the Western Regional Research Committee W-42, financed by the Federal Government and cooperating state agricultural experiment stations. More of this is needed. If administrators are to create master plans for water resources and are to choose intelligently between competing projects, they will need economic and legal help. (See W69-08088). (Loeb-Rutgers)
W69-08091

OUR NATION'S WATER RESOURCES--POLICIES AND POLITICS,
Chicago Univ., Ill.
For primary bibliographic entry see Field 06B.
W69-08094

THE STUDY OF WATER RESOURCES ORGANIZATIONS AS POLITICAL SYSTEMS,
Michigan Univ., Ann Arbor. Dept. of Political Science.
Robert H. Pealy.
Johns Hopkins University, Water Management Seminars, pp 236-252, October 1964 to May 1965. 17 p, 23 ref.

Descriptors: *Political aspects, *Water resources development, river basin commissions, Motivation, administrative agencies.
Identifiers: Ideology, Arkansas-White-Red Basins, Inter-Agency Commission, U.S. Study Commission, Southeast River Basins.

The thesis, that governments are political systems and organizations, and that organizations are government and, therefore, political systems, is examined vis-a-vis water resource organizations. The author contends that water resources planning and development functions may be in part governed by a political or functional sub-culture and that such sub-cultures have a great deal to do with policy outcomes. The article is based on the proposition that there is a legitimate sphere for the operation of political phenomena in water resources organization, and that the study of this phenomena can be profitable. Recent research indicates that major changes in formal organizations and structures would make rational planning for the development of water resources possible. However, institutions (i.e., Congress, water agencies, and clientele) resist major changes with the result that only incremental changes have occurred. While these incremental changes have cumulatively produced substantial changes, there has been little effort to systematically evaluate the effects or the efficiency of these changes. The author takes issue with the widely

held notion that if only political forces could be prevented from interfering, plans and projects that would benefit the public interest would ensue. A methodology is developed for analyses of water resource organizations that is based on role analysis in examining the policy process. The major policies by three organizations are described and analyzed: The Arkansas-White-Red Basins Inter-Agency Committee (AWRBIAC); Texas; and Southeast River Basins. The findings presented the influences of role expectations, orientations, ideology and perceptions of relevance in the making of policy in water resources organizations. (Starr-Chicago)
W69-08100

WATER RESOURCES LAW - POLICIES, MECHANISMS AND DOCTRINES,
Wyoming Univ., Laramie. Coll. of Law.
Frank J. Trelease.
John Hopkins University, Water Management Seminars, pp 317-330, October 1964 to May 1965. 14 p, 2 ref.

Descriptors: *State jurisdiction, *Federal jurisdiction, *Federal-state water rights conflict, Riparian waters, Prior appropriation, Public benefits, Public rights, Optimum development plans.
Identifiers: Maximization, Optimum good.

Law is viewed by the author as the machine established by man to accomplish the aims of man. Outlined are the policies behind the law, the mechanisms it uses and how these are translated into doctrines vis-a-vis water resources. These laws are divided into three categories and described: (1) state water law -- the maximization or optimization policy; (2) federal water law -- national policies; and, (3) state-federal conflicts. The positive aspects of these types of water resource laws are stressed; however, recognition is given to the fact that laws often do not meet the goal of optimum use, are often barriers to desirable action, and fall short of producing optimum utilization of waters. Since law reflects the needs and desires of the people and their legislators, it is essential that information be disseminated to enlighten the public so they might create the pressures for changes in the law and existing institutions. (Starr-Chicago)
W69-08102

SOME ASPECTS OF PUBLIC ORGANIZATION FOR WATER MANAGEMENT,
Syracuse Univ., N. Y. Dept. of Political Science.
Roscoe C. Martin.
Johns Hopkins University, Water Management Seminars, pp 253-263, October 1964 to May 1965. 11 p, 11 ref.

Descriptors: *Regional analysis, *Administrative agencies, Federal project policy, Inter-agency cooperation, St. Lawrence River Commission, Tennessee Valley Authority Project, Water resources development.
Identifiers: *Special districts.

The article is a discussion of water management as the crucial step in a water program. An examination of the governmental organization available for water management responsibilities is done and an assumption is made that water resources administration is a new function of government and one which is extremely difficult to fit into the traditional framework of government. Regional administration as at least a partial answer to the problems of water management is considered. The problem of defining a region is noted -- a geographer views a region differently than a public administrator. The author defines a region as an administrative region, one that does not fit into the traditional pattern of government in this country. Water resources management regions, for the sake of this examination, are divided into four major categories: (1) intrastate action; (2) interstate action; (3) federal regional water agency (TVA) -- river watershed; and, (4) international agreement (St. Lawrence). Recognized are the limitations on the region as a geographical basis for public organization. Because there is nothing better available, special ad hoc arrangements handle most water resources management efforts. These are usually single-purpose special districts. No viable alternative to the special district has been proposed so this trend is likely to continue. (Starr-Chicago)
W69-08103

BACKGROUND OF THE WATER RESOURCES PROBLEM,
Resources for the Future, Inc., Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-08106

WHY MANAGE WATER,
Johns Hopkins Univ., Baltimore, Md.
Abel Wolman.
Johns Hopkins University, Water Management Seminars, pp 3-12, October 1964 to May 1965. 10 p, 4 ref.

Descriptors: *Federal project policy, *Institutional constraints, *Political aspects, *Social aspects, Tennessee Valley Authority Project, Benefit-cost ratio.

The dominant hypotheses in the history of water development are reviewed from the emphasis upon economics in the interval from 1930 to 1940 to the present emphasis upon water quality. An analysis of past and present development indicates that the use of water must be a function of time and of the social purposes of the era. The management problems of water are described as being involved in kenetic planning -- any static plan for present and future objectives is marked for failure. At the present time the benefit-cost ratio may no longer be as valid a basis for water management to meet pressures of a socio-political nature. The TVA direction of total basin management and control is cited as a successful effort whose example has not been transferred to other river basins in the United States. The river basin as a topographic and hydrologic unit is seen as having validity but whether it provides a logical way to provide economic, political and social development is doubtful. The author predicts that regional emphasis may dislodge basin emphasis. Meter problems in metropolitan complexes are intensified not because of a shortage of water but because of lack of machinery for management and finance, which stems from lack of previous planning and from the existence of multiple responsibilities and competitive political units of government. National water policy is seen as developing in an ad hoc fashion and tempered by political doctrines and presents the greatest challenge for improvement to the professional. (Starr-Chicago)
W69-08107

WINDFALL GAINS FROM TRANSFER OF WATER ALLOTMENTS WITHIN THE COLORADO-BIG THOMPSON PROJECT,
Economic Research Service, Washington, D. C.; and Colorado State Union, Fort Collins.
Raymond L. Anderson.
Land Economics, Vol. 43, No 3, pp 265-273, August, 1967. 9 p, 6 ref.

Descriptors: *Allotments, Water rights, Legislation, Economics, Economic justification, Water utilization, Economic efficiency, Third party effects, Marginal utility, Domestic water, Irrigation water.
Identifiers: *Windfall gains, Colorado-Big Thompson project.

The paper defends existing legislation that allows owners of water rights developed under government financed projects to capture a windfall gain when they sell property. The paper evaluates the argument for recapturing windfall gains for the government. If an allotment holder no longer has use for the water and desires to sell it, he should not gain a windfall; however, very seldom does an allotment holder have no further use for his water. Selling an allotment is a negotiation between users, not a user and a non-user. The purposes of the Colorado-Big Thompson project are not violated by the transfer of allotments. Efficiency gains from transfer are discussed. So long as third parties are unaffected by trade, trading of allotment will tend to the greatest possible efficiency. The economic argument for allowing continued transfer of Colorado-Big Thompson allotments is based on marginal value. Whenever marginal value in use is greater in one employment than another, resources should move from lower value uses to higher value uses. Domestic water users in the Colorado-Big Thompson project have a considerably higher valued demand than irrigation users. (Gossen-Chicago)
W69-08111

A LEGAL-ECONOMIC ANALYSIS OF ADMINISTRATIVE AND MARKET PROCEDURES USED IN THE TRANSFER OF WATER RIGHTS,
Nebraska Univ., Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 06C.
W69-08115

6F. Nonstructural Alternatives

THE VALUE OF WATER IN ALTERNATIVE USES WITH SPECIAL APPLICATION TO WATER USE IN THE SAM JUAN AND RIO GRANDE BASINS OF NEW MEXICO.
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 06B.
W69-08087

THE PERCEPTION OF NATURAL HAZARDS IN RESOURCE MANAGEMENT,
Toronto Univ., (Ontario); and Clark Univ., Worcester, Mass.
For primary bibliographic entry see Field 06B.
W69-08099

6G. Ecologic Impact of Water Development

DEVELOPMENT IN THE POOR NATIONS: HOW TO AVOID FOULING THE NEST,
Luther J. Carter.
Sci, Vol 163, No 3871, pp 1046-1048, Mar 1969. 3 p.

Descriptors: *Environment, *Environmental effects, *Ecology, Planning, Natural resources, Policy matters, Reservoirs, Water pollution, Hazards, Conservation, Pesticides, Resource conservation, *Resource development, Disasters, *Water resources development, Foreign projects, *River basin development, Health, Wildlife, Habitats.
Identifiers: Economic growth, Developing countries, International projects.

Development has always carried a connotation of something necessarily good and representing progress. Little thought has been given to environmental problems arising from development. The price of development has included pollution, loss of farmland and habitat for people and wildlife, and the spread of disease. Some environmental disruption is unavoidable in development, but ecological studies and careful-planning case histories show destructive consequences from development in the Amazon Basin of Brazil, the Kariba Dam between Zambia and Rhodesia, the Aswan High Dam in Egypt, the Canete Valley of Peru, and the Oceanic Islands. A 3-day conference was held near Washington, D C, in 1968, on the ecological aspects of international development. The divergent views on conservation and exploitation expressed at the meeting by agricultural scientists, ecologists, and economists are summarized. (USBR)
W69-07773

THE CONCEPTUAL FORMULATION AND MATHEMATICAL SOLUTION OF PRACTICAL PROBLEMS IN POPULATION INPUT-OUTPUT DYNAMICS,
Department of Agriculture, Ottawa (Canada). Statistical Research Services.
K. E. F. Watt.
Symp Bristish Ecological Soc, March 28-31, 1960, Durham, England. In the exploitation of Natural Animal Populations, LeCren, E D and Holdgate, M W (eds), John Wiley and Sons, Inc, New York, pp 192-203, 1062. 40 ref.

Descriptors: *Biomass, *Productivity, *Yield equations, Optimization.
Identifiers: *Productivity models, *Exploited populations, Resource management, Population ecology.

In the face of an expanding population, resource management will depend on precise estimates of the production of renewable natural resorces and determination of how maximum levels of production can be attained and maintained. A review of examples of exploited populations presents certain problems common to all: maximization of a sustainable yield, harvesting techniques, rhythmic cycles in productive systems, time lag between manipulation and results, differing rates of efficiency, the multiplicity of factors governing biological productivity, and the multiplicity of causal pathways by which productivity is modified. The maximum biomass yield that is repeatedly sustainable per unit time is equal to the total biomass produced in that interval minus that biomass needed to guarantee replacement of the yield in the next interval of time. A sample set of equations is developed for this relationship, leading to a yield equation which incorporates density effects on fecundity and reproduction. An introduction to the mathematical literature in optimization and maximization procedures is given. (Voigtlander-Wisc)
W69-07816

ECOLOGICAL HISTORY OF THE ENGLISH LAKE DISTRICT,
For primary bibliographic entry see Field 02H.
W69-07828

THE HUMAN ECOLOGY OF COASTAL FLOOD HAZARD IN MEGALOPOLIS,
Toronto Univ. (Ontario), and Clark Univ., Worcester, Mass.
Ian Burton, Robert Kates, and Rodman Snead.
Contract No NONR 4043 (00), NR 388-073. Chicago Univ Dep Geogr Res Pap No 115, 1969. 196 p, 51 fig, 47 tab, 89 ref.

Descriptors: *Flood damage, *Storms, *Waves (Water), *Coasts, Beach erosion, Flood protection, Non-structural alternatives, Zoning, Recreation, Land use, Industries, Land management, Urbanization.
Identifiers: *Coastal flooding.

The effects of storm flooding on human use of the Atlantic coast of the U.S. from Maine to South Carolina were studied using aerial photographs, surveys, case histories, and economic surveys. The extent of development, patterns of use, human adjustment to flooding, methods of adjustment to hazard, and shore-use policy and regulation are discussed. (Knapp-USGS)
W69-07942

A SYMPOSIUM ON ESTUARINE FISHERIES.
American Fisheries Society, Washington, D. C.
For primary bibliographic entry see Field 02L.
W69-07986

07. RESOURCES DATA

7A. Network Design

NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS, WATER YEAR 1969.
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 05G.
W69-07941

APPLICATION OF THE HYDRAULIC ANALOGY TO FIELD AMPLIFIER DESIGN (FRENCH),
Department of Sciences, Toulouse (France).
For primary bibliographic entry see Field 02A.
W69-08020

7B. Data Acquisition

THE RESULTS OF CONTINUOUS BED LOAD MEASUREMENTS RELATED TO FLUCTUATIONS OF THE RIVER BED,
Netherlands Rijkswaterstaat, Arnhem. Section of River studies.
For primary bibliographic entry see Field 02J.
W69-07762

SEDIMENT TRANSPORTATION AND THE MEANS OF ITS ESTIMATION,
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02J.
W69-07763

THIRTY YEARS EXPERIENCE WITH FIELD INSTRUMENTATION OF EARTH DAMS,
Bureau of Reclamation, Denver, Colo.
Fred C. Walker.
Pap, 18th Annu Soil Mech Conf, Lawrence, Kans, Mar 1969. 20 p.

Descriptors: *Earth dams, *Instrumentation, Dam design, Dam failure, Dam foundations, *Performance tests, Performance, Structural behavior, Earthquakes, Measuring instruments, Settlement, Pore pressure, Seepage, Field tests, Piezometers, Benefits.
Identifiers: Rapid drawdown.

The 3 main reasons for instrumenting an earth dam are: (1) to learn whether the structure performs as anticipated, (2) to monitor the continuing performance, and (3) to increase the knowledge of forces that act on a structure. Much sophisticated and exotic equipment is available for research instrumentation, but a simple instrumentation system is adequate for most routine structures. Collecting and evaluating performance data are continuing operations. The process produces critical and interesting data so infrequently that without special effort an installation may be neglected or abandoned before an event occurs that produces significant results. An earth dam has 3 principal properties whose variation during the life of the structure is of interest: resistance to water movement, resistance to deformation, and strength. The general principles by which data collected from an instrument system can be analyzed to produce an understanding of behavior are described. A few of the more noticeable behavior observations are described and opportunities for further expansion of structural behavior through structure instrumentation are listed. (USBR)
W69-07771

NUCLEAR METHODS IN AIR AND WATER POLLUTION ANALYSIS,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 05A.
W69-07782

THE FACET METHOD,
Losinger and Co., Bern (Switzerland).
Peter Benz.
Int Civ Eng, pp 34-37, Jan 1969. 4 p, 6 fig, 3 tab.

Descriptors: *Cuts, *Excavation, *Estimating, Construction, Earth, Foreign design practices, Foreign construction, Surveying, Boundaries (Surfaces), Volume, Surfaces, Terrain, *Fills, Prisms, Civil engineering.
Identifiers: Switzerland, *Surface area.

The facet method is described for calculating large volumes in construction, such as foundation excavation, cuts and fills, and areas of surfaces. The method requires no special knowledge and can be used by anyone capable of reading a plan having elevation lines. Irregular natural terrain features are represented by a faceted surface composed of triangular planes. The surface area of the terrain is calculated by summing the areas of the triangles. Volumes are calculated by summing the volumes of right triangular prisms lying between the surface of the terrain and a reference plane. Tabulating data for computer processing is discussed. The facet method was developed at Schiffenen Dam, Switzerland, for quantity surveys of (1) mass excavation, (2) rock surface area cleaned before concreting, and (3) concrete work. (USBR)
W69-07791

SAMPLER FOR STUDIES OF THIN HORIZONTAL LAYERS,
Washington Univ., St. Louis, Mo. Dept. of Botany.
Bruce C. Parker, George Leeper, and William Hurni.
Limnol and Oceanogr, Vol 13, No 1, pp 172-175, January 1968. 3 fig, 3 ref.

Descriptors: *Sampling, *Thermal stratification, *Laboratory tests.
Identifiers: *Water sampler, *Horizontal layers, *Instrument sampling pattern, Sampling head, Sampling head slit, Tygon connector tubing, Reel, Pump, Thermistor probe, Dye solution patterns, Torus, Continuous collecting.

Procedure for constructing a water sampler that can locate a thermally stratified layer and collect a sample is described. The assembly consists of two polypropylene funnels connected by a center-mounted screw enabling adjustment of the sampling slit. Attached to the upper cone is the temperature sensing apparatus, a thermistor attached by a Bakelite support and connected to a microphone cable. The entire apparatus is portable and can sample continuously or from a single layer. Laboratory tests conducted to check the effectiveness of the device showed that the conical shape of the sampling head caused little disturbance when moved vertically through water. A tentative conclusion is that the sampling pattern of the instrument resembles either a torus or a toroid with an expanded horizontal dimension. Assuming the former, the device should be more efficient by far than open-ended, vertical samplers for equal volume samples. Considering the increased cross-sectional diameter of the toroidal sampling pattern, when samples exceed a few liters from a horizontal layer, a sampling head of greater diameter or horizontal movement of the sampling head may be necessary to avoid contamination. (Ketelle-Wisc)
W69-07829

RADIONUCLIDE CYCLING BY PERIPHYTON: AN APPARATUS FOR CONTINUOUS IN SITU MEASUREMENTS AND INITIAL DATA ON ZINC-65 CYCLING,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05C.
W69-07862

BIODIALYSTAT: NEW SAMPLER FOR DISSOLVED ORGANIC MATTER,
Washington Univ., St. Louis, Mo. Dept. of Botany.
For primary bibliographic entry see Field 05A.
W69-07865

IN SITU MEASUREMENT OF THE FREE ENERGY OF SOIL MOISTURE BY SMALL HYGROMETERS (PART 1),
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Kazuo Okunishi.
Bull Disaster Prev Res Inst, Kyoto Univ, Vol 18, Part 3, No 142, pp 17-27, Feb 1969. 11 p, 9 fig, 2 tab, 10 ref.

Descriptors: *Soil moisture meters, *Unsaturated flow, *Free energy, *Electrodes, Moisture tension, Moisture content, Hygrometry, Measurement.
Identifiers: Magnetite hygrometers.

A small hygrometer with a sensing element made of magnetite colloid was tested in the laboratory and the field to decide the range of the free energy of the soil moisture within which it can be used with advantage. The results of the tests and the comparison of the different methods for the in situ measurement led to the conclusion that the hygrometer is the best method within the range from pF 4 to pF 6. (Knapp-USGS)
W69-07932

APPLICATION OF MATERIAL AND ENERGY BALANCES TO GEOTHERMAL STEAM PRODUCTION,
Texas A and M Univ., College Station; and Stanford Univ., Calif.
Robert L. Whiting and Henry J. Ramey, Jr.
J Petrol Tech, pp 893-900, July 1969. 8 p, 5 fig, 1 tab, 8 ref, append.

Descriptors: *Geothermal studies, *Steam, *Heat flow, *Thermodynamics, *Thermal power, Thermal springs, Geysers, Water vapor, Thermal powerplants.
Identifiers: Geothermal wells, Geothermal steam wells.

Some basin thermodynamic principles are presented that are applicable to geothermal fluid reservoir engineering. The equations are useful for estimating the initial reservoir conditions and for matching the past performance and predicting the future performance of reservoirs for which the assumptions involved are realistic. Further, it is demonstrated that this approach can be applied to a field case with what appears to be excellent accuracy. Other common reservoir engineering tools can be modified for application to geothermal fluid reservoirs. (Knapp-USGS)
W69-07990

ENVIRONMENTAL STUDIES USING EARTH ORBITAL PHOTOGRAPHY,
IBM Federal Systems Div., Gaithersburg, Md.
F. J. Wobber.
Photogrammetria, Vol 24, No 3-4, Spec Issue, pp 107-165, June 1969. 159 p, 35 fig, 2 plate, 3 tab, 26 ref.

Descriptors: *Photogrammetry, *Satellites (Artificial), Aerial photography, Surveys, Synoptic analysis, Geomorphology, Exploration, Mapping, Spectroscopy, Hydrologic data.
Identifiers: Water resources surveys, Hydrologic surveys.

Orbital remote sensing, and particularly orbital photography, can provide immediately useful data for scientists familiar with applying aerial photographic techniques to environmental problems. Despite the expansion of analytical techniques in the earth sciences, the environmental data base has remained relatively static compared with increased information needs because of the difficulty of effective worldwide surveys and the high cost of timely data collection. Color, color infrared, and black and white space photographs obtained in the Gemini and Apollo programs provide unique synoptic tools for analyzing modern environments and processes, and data that cannot be duplicated by aerial photographic mosaics. Principal advantages of orbital surveys include repetitious worldwide coverage promising environmental synthesis within the full spectrum of seasonal contrasts, and synoptic observations on a scale generally impossible from aircraft. The general categories of environmental data that can be extracted from orbital photography are summarized. Worldwide surveys of marine sedimentation related to offshore bar or reef development can improve navigational safety and coastal engineering activities and provide data related to sediment movement critical to fish migration or reproduction or the hydrodynamics of pollutant movement. Gemini photo-analysis of sediment patterns often show a marked correlation with bathymetric maps and marine bottom topography and suggests surveys of nearshore marine distributary currents may speed location of heavy metal concentrations on the world's continental shelves. (Knapp-USGS)
W69-07992

DISPERSION AND REACTION IN UNSATURATED SOILS APPLICATIONS TO TRACERS,
Grenoble Univ. (France). Laboratoires de Mecanique des Fluides.
For primary bibliographic entry see Field 02G.
W69-07995

WATER CONTENT MEASUREMENT WITH ^{60} keV GAMMA RAY ATTENUATION,
Agricultural Univ., Wageningen (Netherlands); and Technical Univ. of Prague (Czechoslovakia).
P. H. Groenevelt, J. G. de Swart, and J. Cisler.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 67-78, June 1969. 12 p, 9 fig, 5 ref.

Descriptors: *Soil moisture meters, *Nuclear moisture meters, *Instrumentation, Nuclear meters, Gamma rays, Spectrometers, Absorption, Porosity.
Identifiers: Gamma attenuation moisture meters, Americium, Gamma-ray spectrometers.

The specific problems dealing with the use of Americium 241 for measuring the water content of soil sample by attenuation of low energy gamma rays are discussed. One of the advantages is that the optimum thickness of the soil sample is about 4 to 5 cm. However, one of the difficulties encountered is related to the determination of the absorption coefficient, which is generally lower than the theoretical value. Special attention is drawn to the problems of counting-losses in the gam10bma spectrometer system. Experimental results are presented showing the importance of the system geometry. (Knapp-USGS)
W69-07997

SOME CONSIDERATIONS ON THE EMPLOYMENT OF TENSIOMETERS (FRENCH),
Toulouse Univ. (France). Institut de Mecanique des Fluides.
L. Sormail.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 79-94, June 1969. 16 p, 7 fig, 3 tab, 8 ref.

Descriptors: *Tensiometers, *Soil moisture meters, Moisture tension, Instrumentation, Research and development, Moisture content, Soil moisture, Calibrations, Measurement.
Identifiers: Tensiometer calibration and testing.

The interpretation of tensiometer measurement requires special knowledge of the mechanics of equilibrium of the tensiometer with its environment. The classical concept of response time of the system consisting of a porous cup and a manometer can be improved by taking into account the elasticity of the tubing. The role of entrapped air in the circuit is analogous to tubing elasticity. In general, it is possible to study the response characteristics of the tensiometer by imposing pressure steps on the system and by studying the equilibrium response. Such tests showed certain anomalies of behavior which can be attributed to very small bubbles of air entrapped to the internal wall of the porous cup. However, it is necessary to check the response of the tensiometer when it is placed in the soil. This is confirmed by analysis and experiments in sandy and clay soils. (Knapp-USGS)
W69-07998

A MATHEMATICAL FUNCTION FOR DESCRIBING CAPILLARY PRESSURE-DESATURATION DATA,
Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
G. E. Laliberte.
Bull Int Ass Sci Hydrol, Vol 14, No 2, pp 131-149, June 1969. 19 p, 11 fig, 2 tab, 7 ref.

Descriptors: *Soil water movement, *Statistical models, Capillary conductivity, Drainage, Hysteresis, Capillary action, Probability, Porosity, Pores, Saturation, Moisture content.
Identifiers: Probability density function.

The equations of Brooks and Corey for relating effective saturation to capillary pressure describe experimental data quite well for small values of saturation but overestimate pressure as saturation approaches unity. Using assumed functions for the distribution of pore volume with respect to pore radius, Brutsaert was able to describe experimental data satisfactorily, provided that constants such as mean pore radius and the standard deviation of pore radius were determined from distribution functions derived from experimental data, rather than from the assumed functions. White developed a mathematical model which described experimental data satisfactorily but the technique required the determination of 13 constants describing the relationship. In this paper, a pore-volume probability density function is introduced which permits the development of a function for describing effective saturation in terms of dimensionless capillary pressure, that is, capillary pressure scaled in terms of bubbling pressure. The capillary pressure-saturation data on the drainage cycle are described better by the new function than by the equations of Brooks and Corey. The correspondence between experiment and theory is better at small values of saturation than for values approaching unity. The relationship between saturation and pressure is characterized by 3 constants, each of which is, in turn, a function of the pore-size distribution index. Two of the constants are related to mean pore radius and to the standard deviation of the pore-volume distribution. (Knapp-USGS)
W69-07999

GROUNDWATER STUDIES IN THE SABI VALLEY, RHODESIA, USING NATURAL TRITIUM MEASUREMENTS,
Agricultural Research Council of Central Africa.
Hydrology Research Team.
For primary bibliographic entry see Field 02F.
W69-08004

ULTRASONIC FLOWMETERS FOR MEASURING RIVER TURBULENCE,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Yasuo Ishihara, and Shoitiro Yokosi.
Bull Disaster Prev Res Inst, Kyoto Univ, Vol 18, Part 3, No 144, pp 49-64, Feb 1969. 16 p, 17 fig, 2 photo, 9 ref.

Descriptors: *Flowmeters, *Turbulence, *Ultrasonics, Turbulent flow, Instrumentation, Eddies, Streamflow, River flow.
Identifiers: Ultrasonic turbulence meters.

Two kinds of ultrasonic flowmeters have been developed for the precise measurement of turbulent velocity in streams. One is based on the circuit transit-time method, and the other on the method of phase difference. The circuit transit-time method is able to measure 2 components of velocity simultaneously. These flowmeters have a number of excellent features: high sensitivity, low inertia, complete linearity, high stability, and independence of temperature variation. The characteristic size of the sensor of both flowmeters is only

3 cm. An adequate combination of the sensors of both flowmeters makes it possible to measure 3 components of turbulent velocity simultaneously. The principle of operation, instrumentation, calibration and several problems are described. The effect of sensor size and the duration of observation on measured spectrum are discussed and a brief description of observations using the flowmeters is presented. (Knapp-USGS)
W69-08017

7C. Evaluation, Processing and Publication

SOLUBILITY OF GYPSUM IN AQUEOUS ELECTROLYTES AS AFFECTED BY ION ASSOCIATION AND IONIC STRENGTHS UP TO 0.15M AND AT 25 DEG C,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 02K.
W69-07700

HYDROGRAPH SYNTHESIS BY DIGITAL COMPUTER,
Texas A and M Univ., College Station. Dept. of Meteorology.
For primary bibliographic entry see Field 02E.
W69-07706

TIME SERIES ANALYSIS OF HYDROLOGIC DATA,
Arizona Univ., Tucson. Office of Hydrology and Water Resources.
Chester C. Kisiel.
Advance in Hydroscience, Vol 5, pp 1-119, 1969. 119 p, 54 fig, 10 tab, 171 ref.

Descriptors: *Statistical methods, *Model studies, *Stochastic processes, *Time series analysis, *Hydrologic aspects, Computer models, Statistical models, Linear programming, Fourier analysis, Correlation analysis, Regression analysis, Synthetic hydrology.
Identifiers: Spectral analysis, Harmonic analysis.

The use of time series analysis for the study of hydrologic data is discussed in a thorough introduction to mathematical model-making techniques. A bibliography of 171 references is included. Spectrum analysis is a powerful tool for the organization and implementation of field data collection programs. Time series analysis techniques recognize the variability of natural events and the presence of noise. Model studies must incorporate much of the complexity of natural events and detect nonlinear and nonstationary components of natural processes; however, many problems may be studied by the simplifying assumption of stationary stochastic inputs into linear time-invariant systems with stationary stochastic outputs. For main entry see W69-07723. (Knapp-USGS)
W69-07724

QUALITY OF SURFACE WATERS FOR IRRIGATION IN WESTERN STATES--1964.
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 03F.
W69-07732

WATER RESOURCES OF THE BELLE RIVER BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Washington, D. C.
R. L. Knutilla.
Geol Surv Hydrol Invest Atlas HA-317, 1 sheet, 1969. Text, 5 fig, 7 map, 2 tab.

Descriptors: *Water resources, *Michigan, *Surface waters, *Groundwater, Streamflow, Water wells, Water yield, Aquifers, Glacial drift, Water quality, Water levels, Water sources, Hydrologic data.
Identifiers: Belle River Basin (Mich).

The water resources of the Belle River Basin, southeastern Michigan are described in a 1-sheet hydrological atlas consisting of maps, graphs, tables and text. Streamflow is summarized and tabulated. Groundwater is obtained mainly from glacial drift deposits, in which yields may be over 100 gpm. Bedrock wells in the western end of the basin yield as much as 100-500 gpm, and in the eastern end yields are commonly less than 10 gpm. Some water from bedrock wells in the eastern part of the basin is too salty for most uses. (Knapp-USGS)
W69-07734

FLOODS AT AMESVILLE, OHIO,
Geological Survey, Washington, D. C.
Ronald I. Mayo, and Earl E. Webber.
Geol Surv Hydrol Invest Atlas HA-324, 1 sheet, 1969. Text, 6 fig, 1 map, 1 tab, 2 ref.

Descriptors: *Floods, *Ohio, *Stage-discharge relations, Discharge (Water), Streamflow, Hydrographs, Flood plains, Flood damage, Peak discharge, Hydrologic data.
Identifiers: *Amesville (Ohio).

Data are presented for use in evaluating the extent and depth of flooding that can be expected along Federal Creek, McDougal Branch, Sharps Fork, and Linscott Run, Amesville, Ohio. Flood frequencies are shown by graphs. Flood profiles showing flood heights are constructed from data obtained from crest-stage stations and flood marks. (Knapp-USGS)
W69-07735

FLOODS IN WILTON CENTER QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Washington, D. C.
Howard E. Allen, and Allen W. Noehre.
Geol Surv Hydrol Invest Atlas HA-304, 1 sheet, 1969. Text, 11 fig, 1 map, 2 tab, 3 ref.

Descriptors: *Floods, *Illinois, *Hydrographs, Stream gages, Stage-discharge relations, Streamflow, Flood plains, Flood damage, Peak discharge, Hydrologic data.
Identifiers: Wilton (Ill).

Floods in the Wilton Center quadrangle, northeastern Illinois, are described in a 1-sheet hydrological atlas consisting of maps, charts, tables, diagrams, profiles, and graphs. Flooded areas, locations of gages, and location are shown by maps. Flood frequencies are shown by graphs. The hydrological data may be used to evaluate depth, extent, and frequencies of floods that affect the development of flood plains in the area. (Knapp-USGS)
W69-07736

FLOODS ON LITTLE BUFFALO CREEK AT WEST JEFFERSON, NORTH CAROLINA,
Geological Survey, Washington, D. C.
William J. Haire.
Geol Surv Hydrol Invest Atlas HA-331, 1 sheet, 1969. Text, 4 fig, 1 map, 2 tab, 2 ref.

Descriptors: *Floods, *North Carolina, *Stage-discharge relations, Discharge (Water), Streamflow, Hydrographs, Flood plains, Flood damage, Peak discharge, Hydrologic data.
Identifiers: *West Jefferson (NC).

Data are presented for use in evaluating the extent and depth of flooding that can be expected on Little Buffalo Creek near West Jefferson, North Carolina. Flooded areas are shown on an air photograph scaled about 1 inch to 500 ft. Flood frequencies are shown by graphs. Flood profiles showing flood heights are constructed from data obtained from crest-stage stations and flood marks. (Knapp-USGS)
W69-07737

SIMULTANEOUS USE OF AN ANALOG SINGLE-PURPOSE ELECTRONIC COMPUTER AND A PHYSICAL MODEL OF A WATERSHED,
Prague Agricultural Univ. (Czechoslovakia). Dept. of Water Resources.
For primary bibliographic entry see Field 02A.
W69-07743

WATERSHED SIMULATION BY ELECTRONIC ANALOG COMPUTER,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
W69-07744

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO A STUDY OF WATER RESOURCES MANAGEMENT,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06D.
W69-07745

APPLICATION OF ANALOGUE COMPUTERS FOR PREDICTING THE GROUND WATER REGIME OF ARTESIAN BASINS UNDER CONDITIONS OF THEIR DEVELOPMENT,
All-Union Research Inst. of Water Supply, Drainage, Hydro-Engineering Works and Engineering Hydrogeology, Moscow (USSR).
For primary bibliographic entry see Field 02F.
W69-07746

FLOW DURATION OF OHIO STREAMS,
Geological Survey, Columbus, Ohio.
William P. Cross.
Ohio State Dept Natur Resources, Div of Water Bull No 42, 1968. 68 p, 1 plate, 2 tab, 2 ref.

Descriptors: *Streamflow, *Frequency analysis, *Ohio, *Data collections, Discharge (Water), Hydrologic data, Stream gages, Surface waters, Duration curves, Depth-area-duration analysis, Runoff.
Identifiers: Flow duration.

Flow durations of Ohio streams are computed and presented in tables. Records of 164 gaging stations for the 10 yr period ending Sept. 30, 1965 are tabulated. (Knapp-USGS)
W69-07753

PRINCIPAL LAKES OF THE UNITED STATES,
Geological Survey, Washington, D. C.
Conrad D. Bue.
Geol Surv Circ No 476, 1963. 22 p, 5 fig, 6 tab, 36 ref.

Descriptors: *Lakes, *Fresh water, *Bibliographies, *United States, Recreation, Great Lakes, Lake morphology, Geologic control, Glaciation, Depth, Saline lakes.
Identifiers: *Natural lakes, *Glossary.

To fill a need for general information on lakes for the nontechnical reader, this report presents mostly a glossary of United States lakes that have surface areas of 10 sq mi or more. Of the approximately 250 fresh-water lakes in this size range, 100 are in Alaska and 100 are in Minnesota, Wisconsin, Michigan, New York and Maine. Excluding the Great Lakes, 34 of the fresh-water lakes have maximum depths of 250 ft or more, of which 20 are known to be in Alaska. Since many lakes in Alaska have not been sounded, other lakes doubtless will be found to be more than 250 ft deep. The water stored in natural lakes--exclusive of the Great Lakes--is much greater in amount than that stored in all artificial reservoirs, but in economic value the man-made reservoirs are more valuable. Natural lakes are best known for their recreational advantages. (Lang-USGS)
W69-07770

PERT SIMULATION: A DYNAMIC APPROACH TO THE PERT TECHNIQUE,
Oregon State Univ., Corvallis; and Foamat Foods Corp., Corvallis, Oreg.
Clifford F. Gray, and Robert E. Reiman.
J Syst Manage, Vol 20, No 3, pp 18-23, Mar 1969. 6 p, 6 fig, 2 tab, 7 ref.

Descriptors: *PERT, Project planning, Programs, *Planning, Estimating, Time, Probability, Management, Simulation, Monte Carlo method, Decision making, Models, Design tools, *Critical path method, *Scheduling, Operations research, Computers.
Identifiers: Network analysis.

PERT Simulation is a new technique for coping with uncertainty and instability of time estimates in the early stages of project management. Large complex PERT networks with several closely timed critical paths have a high probability that the actual critical path may shift several times during the course of project work. Standard PERT analyses are based upon estimates of mean activity duration times and give little information on what happens if the activity time varies. PERT Simulation incorporates the variance or uncertainty of actual duration time into the analysis by a probability distribution for duration time. The likelihood of critical path shifting is evaluated by determining the relative probabilities of each network activity and of each alternative path becoming critical. The transformation of the standard PERT model to PERT Simulation is described; some key points are noted for network analysis under this system. Two examples of applications are given. Advantages and some observations regarding the use of PERT Simulation are listed. (USBR)
W69-07775

USE OF ANALOG COMPUTERS FOR SIMULATING THE MOVEMENT OF ISOTOPES IN ECOLOGICAL SYSTEMS,
Vanderbilt Univ., Nashville, Tenn. Graduate School.
For primary bibliographic entry see Field 05B.
W69-07819

COMPUTER APPLICATIONS IN HYDROLOGY IN KANSAS,
Geological Survey, Lawrence, Kans.
Charles O. Morgan, Jesse M. McNellis, and Brent H. Lowell.
Kans State Geol Surv Bull 194, Part 1, Short Pap on Res in 1968, pp 3-7, Feb 1969. 5 p, 5 fig, 2 tab, 11 ref.

Descriptors: *Hydrologic data, *Data collections, *Data processing, *Data storage and retrieval, *Kansas, Digital computers, Computer programs, Mapping, Contours, Water quality, Water wells, Aquifers, Water levels.
Identifiers: U. S. Geological Survey (Kans Dist).

The Kansas District of the Water Resources Division, U.S. Geological Survey, in cooperation with the State Geological Survey of Kansas, has been establishing a data-processing system, including storage and retrieval, for hydrologic data since 1963. The data bank developed contains thousands of well-inventory, water-quality, water-level, and lithologic-log records. Accuracy of data in the bank is assured through a system that begins with coded forms, includes computer programs that check for logic errors, and ends with manual proofing of computer output. Numerous computer programs that manipulate and analyze data from the bank have been written, and these programs have enhanced the interpretive capability of a hydrologist. Methods of examining data that were not practicable before the advent of the computer are now feasible. Use of the computer has encouraged development of new analytical techniques and the adaptation of methods from other scientific fields for the interpretation of hydrologic data. Utilizing a high-speed digital computer, the Kansas District can do specific tasks, achieving higher interpretive quality in less time and at a lower cost than was possible previously. (Knapp-USGS)
W69-07930

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO THE EVALUATION ON THE EFFECTS OF URBANIZATION OF THE RUNOFF CHARACTERISTICS OF SMALL WATERSHEDS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 04C.
W69-07951

SPECIALIZED ANALOG COMPUTERS FOR HYDROLOGICAL CALCULATIONS AND FORECASTS,
Hydrometeorological Centre, Moscow (USSR).
A. G. Levin.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 67-72, 1968. 6 p, 5 fig, 3 ref.

Descriptors: *Analog computers, *Streamflow forecasting, Flood forecasting, Runoff forecasting, Weather forecasting, Forecasting, Routing, Warning systems.
Identifiers: *USSR, Rainfall forecasting, Rain-flood forecasting.

The analog computer used for hydrologic forecasts in the USSR is described. Its capabilities include forecasts of rainfall, rainfall floods, hydrograph analysis and routing. (Knapp-USGS)
W69-07952

THE SOLUTION OF DIRECT AND INVERSE PROBLEMS OF OUTLET WAVES SPREADING ON ANALOG COMPUTERS,
Ministry of Reclamation and Water Economy, Erevan (USSR). Water Problems and Hydrotechnics Research Inst.
K. Kh. Hovsepian, R. S. Avetisian, and A. G. Nazarian.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 73-80, 1968. 8 p, 6 fig, 6 ref.

Descriptors: *Analog computers, *Open channel flow, *Routing, Hydraulics, Canals, Irrigation water, Discharge (Water).
Identifiers: *USSR, St. Venant's equation.

An analog computer is used in the USSR to solve canal inflow-outflow wave relationships, using St. Venant's equation. Comparison of observed and computed hydrographs shows the good accuracy of the method. (Knapp-USGS)
W69-07953

THE MAR ANALOG COMPUTER FOR MODELLING HYDROLOGICAL SERIES BY THE MONTE CARLO METHOD,
For primary bibliographic entry see Field 02A.
W69-07954

ESTIMATION OF FLOODS WITH THE AID OF ANALOGUE COMPUTERS,
Gidrometeorologicheskii Institut, Leningrad (USSR).
For primary bibliographic entry see Field 02E.
W69-07955

NEW APPROACH SUGGESTED FOR DESIGN OF ELECTRICAL ANALOG COMPUTERS FOR GROUNDWATER FLOW STUDIES,
Tata Inst. of Fundamental Research, Bombay (India).
For primary bibliographic entry see Field 02F.
W69-07956

UTILIZATION OF THE ANALOG COMPUTER FOR SIMULATING THE SALINITY FLOW SYSTEM OF THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02E.
W69-07957

DIGITAL COMPUTER SOLUTIONS FOR FLOOD HYDROGRAPH PREDICTION FROM RAINFALL DATA,
Technische Hochschule, Munich (West Germany). Hydraulics Research Station Obernach.
For primary bibliographic entry see Field 02A.
W69-07958

DETERMINATION OF THE RUNOFF HYDROGRAPH ON A DETERMINISTIC BASIS USING A DIGITAL COMPUTER,
Technical Univ. of Budapest (Hungary).
For primary bibliographic entry see Field 02A.
W69-07959

DETERMINATION OF THE QUANTITY OF WATER TO BE STORED BY DIGITAL COMPUTERS,
Institute of Research of the Hydraulic Resources, Budapest (Hungary).
For primary bibliographic entry see Field 04A.
W69-07960

HYDROGEOLOGIC DATA FROM CHEYENNE, DECATUR, RAWLINS, SHERIDAN, SHEMAN, AND THOMAS COUNTIES, KANSAS,
Kansas State Geological Survey, Lawrence; and Geological Survey, Lawrence, Kans.
Katherine M. Keene, Richard H. Pearl, and Marilyn E. Pabst.
Kans Ground Water Basic Data Release No 1, 1969. 113 p, 1 fig, 1 plate, 5 tab.

Descriptors: *Data collections, *Hydrologic data, *Water wells, *Kansas, Aquifers, Water quality, Water levels, Observation wells, Water-level fluctuations, Groundwater.
Identifiers: Cheyenne County, Decatur County, Rawlins County, Sheridan County, Sherman County, Thomas County (Kans), Periodic observations.

Groundwater basic data are compiled for the 6 northwestern counties of Kansas. Records of 1,685 wells are tabulated. Observation well records show seasonal water-level fluctuations for periods as long as 26 yr. Chemical analyses are tabulated for 351 representative wells. Lithologic logs of 334 test holes are included. The Ogallala formation and alluvial deposits yield moderate to large amounts of water to wells. Other aquifers are less productive. (Knapp-USGS)
W69-08018

FUNCTION SPACE APPROACH TO PARAMETER IDENTIFICATION IN DISTRIBUTED SYSTEMS,
Hitachi Research Lab., Ibaraki (Japan); and California Univ., Los Angeles.
For primary bibliographic entry see Field 02A.
W69-08023

MATHEMATICAL SIMULATION OF WATER MOVEMENT THROUGH UNSATURATED NONHOMOGENEOUS SOILS,
Harvard Univ., Cambridge, Mass. Dept. of Water Resources.
For primary bibliographic entry see Field 02G.
W69-08026

BASIC DATA FOR URBAN HYDROLOGY STUDY, DALLAS, TEXAS--1966,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W69-08056

08. ENGINEERING WORKS

8A. Structures

RIVER DIVERSION FOR BOUNDARY DAM,
Bechtel Corp., San Francisco, Calif.
Adolf A. Schilling.
Prepr 787, Amer Soc Civ Eng Annu Meet Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 25 p, 12 fig.

Descriptors: *Diversion, *Diversion structures, *Diversion tunnels, Diversion works, Diversion dams, Cofferdams, Arch dams, Tunnel linings, Underground powerplants, Tunnel plugs, *Tunnels, Intake structures, River closures, Gunite, Blasts, Construction.
Identifiers: *Overtopping, Boundary Dam (Wash), Blasting.

Diverting the Pend Oreille River at Boundary Arch damsite, Wash, was accomplished by constructing 2 rockfill cofferdams and a 42-ft horseshoe tunnel in the left abutment. Although this scheme followed generally accepted practice, several unique features were incorporated in the design and construction. Tunnel excavation was performed from the inside of the arch dam abutment via an adit from the underground powerplant, leaving a rock plug at each tunnel portal. Opening the portals and rerouting the river was accomplished by a series of singular rock blasts. The tunnel floor was left unlined; gunite was applied to the side walls and roof to improve hydraulic performance. The capacity of the diversion scheme was limited to river discharges during the low flow periods; flood flows were discharged over the partly completed arch dam. The diversion tunnel was closed by lowering a counterbalanced, arched, steel gate into the flow at the tunnel during diversion; a second plug sealed the diversion tunnel after closure. (USBR)
W69-07784

DIVERSION WORKS, SNETTISHAM PROJECT,
Corps of Engineers, Anchorage, Alaska.
Thomas E. Munsey.
Prepr 824, Amer Soc Civ Eng Annu Meet Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 17 p, 8 fig, 5 ref.

Descriptors: *Diversion works, *Diversion, *Diversion tunnels, Lakes, Alaska, Outlet works, Outlets, Hydroelectric power, Underwater construction, Underwater television, Core drilling, Tunnels, *Tunnel construction, Instrumentation, Tunneling, Joints (Geology).
Identifiers: Outlet tunnels, Underwater explosions, *Rock traps, Underwater photography, Snettisham Proj (Alaska).

The Norwegian method of lake piercing is being used to temporarily lower the water surface of a southeastern Alaska lake 130 ft below its natural level. After the surface drops, a power intake works will be constructed just above the low-water level, making available for hydropower development 110,000 acre-ft of natural storage which would have been lost had a more conventional means of diversion been used. Preliminary exploration included core borings, soundings, and examination with an underwater TV camera. Design and final profile of the tap, rock trap, and outlet tunnel are described. To illustrate typical problems in lake piercing, an account of the excavation of the most critical portion (the last 100 ft of the tunnel and rock trap) is given. Alterations in the tapping setup and procedure are the rule rather than the exception during construction. (USBR)
W69-07787

FACTORS OF SAFETY IN THE DESIGN OF BURIED PIPELINES,
Iowa State Univ. of Science and Technology, Ames.
M. G. Spangler.
Prepr ERI 359, Annu Meet Highw Res Bd, Nat Res Counc, Jan 1969. 17 p, 6 ref.

Descriptors: *Safety factors, *Safety, *Pipelines, Pipes, Design, Soil pressure, Pressure distribution, Lateral forces, Ultimate loads, Bending moments, *Concrete pipes, *Steel pipes, Loads (Forces), Shear strength, Shear stress, Structural design, Reinforced concrete, Culverts.
Identifiers: Pipe bedding, Pipe cover, Pipe cradles, Flexible pipes, Pipe laying, *Pipe design, Soil-structure interaction, Ultimate strength.

Factor of safety may be broadly defined as the ratio of the maximum load that a structure is capable of supporting to the load that the structure is designed to carry. This ratio may be determined and expressed in many ways. A factor of safety of unity is recommended as being adequate and economical for reinforced concrete pipe installations designed on the basis of the minimum 0.01 in. crack 3-edge bearing test strength of the pipe. When designing on the basis of the ultimate test strength, a factor of safety of 1.5 should be used. For nonreinforced rigid pipes, a factor of safety of 1.5, based upon the minimum ultimate test strength, is recommended for general design application, with possible reduction to 1.4 or 1.3 in unusually favorable circumstances. A limiting deflection of 5% of initial diameter is recommended for flexible metal pipe installations. This is approximately one-fourth (factor of safety of 4) of a critical deflection of 20%. The design of longitudinal bolted seams in flexible metal pipes should be based upon the ability of the seam to carry a composite of shear and bending moment stresses and not on shear strength alone. (USBR)
W69-07792

HYDRAULIC DESIGN OF LARGE SURGE TANKS FOR PUMPING PLANTS,
California State Dept. of Water Resources, Sacramento.
Ravinder K. Jain, Roy T. Nakahara, and John W. White.
Tech Memo No 38, Dept Water Resour, Calif, Nov 1968. 30 p, 9 fig, 1 tab, 5 ref.

Descriptors: *Surge tanks, Water hammer, *Hydraulic design, Pressure, Transients, Discharge lines, Energy losses, Graphical analysis, Surges, Hydraulic structures, Pumping plants, Orifices, Analysis.
Identifiers: Tehachapi Pump Plant (Calif), *Pressure waves, *Water column separation.

The hydraulic design of large surge tanks is described, placing emphasis on designs used for the Tehachapi surge tank. Graphical and analytical methods for determining the size of large surge tanks for pumping plants are given. Energy loss coefficients for different orifice configurations tested are included. Surge tanks are used to control transient pressures and to prevent water column separation. Flow in discharge lines communications with the surge tank through orifices connecting discharge lines with the tank. Normal operationproduces changes in flow rates in discharge lines, resulting in positive or negative transient pressure waves reflected at the surge tank as minor fluctuations in water surface elevation protecting discharge lines and downstream tunnels from these surges. During emergency conditions all pumps could be shut down at once by a power failure. This condition causes the pumps to halt, changing rotational direction as soon as water begins to flow back. The reverse flow continues until the downstream valves are closed. To prevent low pressures in discharge lines or water column separation under this condition, water is supplied from the surge tank. (USBR)
W69-07802

TOWARD THE IMPROVEMENT OF THE CONSTRUCTION WORK FOR HYDROELECTRIC POWER PLANTS,
V. L. Kuperman.
Hydrotech Constr, No 8, pp 671-677, Aug 1968. 7 p, 3 fig, 15 ref.

Descriptors: *Construction, *Hydroelectric power, Concrete dams, Cold weather construction, Diversion tunnels, River closures, Cofferdams, Flood routing, Underground structures, *Foreign construction, Tunneling, Underground powerplants, Tunnel linings, Hydraulic structures, Grouting, Construction costs, Bibliographies.
Identifiers: *Construction methods, *USSR, Siberia, Hydroelectric resources, Blasting.

Hydroelectric power construction in the USSR is moving from the European plains of the USSR to the high mountainous regions of Asia and the Siberian rivers. Many innovations in materials and methods are required since the new construction is (1) on rivers having large flows with frequent fluctuations, (2) at sites requiring large concrete dams, and (3) in areas having very severe weather and temperature conditions. New problems pertaining to construction work for power projects include: (1) river diversion, (2) methods of storage during diversion, (3) use of local materials for dams, (4) rock work and special equipment required, (5) earth and concrete work where temperatures may reach 50 deg C below zero, (6) underground construction, and (7) special grouting methods for strengthening existing foundation materials. (USBR)
W69-07809

ROADS AND HIGHWAYS.
For primary bibliographic entry see Field 06E.
W69-07889

ROADS AND HIGHWAYS.
For primary bibliographic entry see Field 06E.
W69-07890

ROADS AND HIGHWAYS.
For primary bibliographic entry see Field 06E.
W69-07891

ROADS AND HIGHWAYS.
For primary bibliographic entry see Field 06E.
W69-07892

PROBLEMS OF STORAGE DAM CONSTRUCTION IN EASTERN HERZEGOVINA (FRENCH),
Stjepan Mikulec.
Hydrol of Fractured Rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 590-598, 1967. 9 p, 3 fig, 4 ref.

Descriptors: *Dam construction, *Karst, *Hydrologic properties, *Engineering geology, Fractures (Geology), Tracers, Water storage, Economics, Rivers, Geophysics, Hydrogeology, Irrigation, Hydroelectric power, Sea level, Geochemistry, Sodium, Fluorescence, Permeability.
Identifiers: *Yugoslavia, Eastern Herzegovina, Trebisnjica River.

Geologic, hydrologic, and economic conditions present in eastern Herzegovina, Yugoslavia, were investigated for the purpose of efficient construction of three dams. One of the dams located on the Trebisnjica river is under construction. Because a large part of the eastern Herzegovian is highly karstified test borings totaling over 10,000 m were made, and sodium-fluorescine tracer techniques were employed to study underground water movement. Underground water channel systems were also investigated by blocking an intermittent stream and some underground channels. It is assumed that the work planned will permit an overall output of 3.5x10 to the 9th power kilowatt hours of electric energy at a cost not exceeding the cost of constructing a power station under normal conditions. (Gabriel-USGS)
W69-07984

A STOCHASTIC MODEL FOR THE RESPONSE OF PERMANENT OFFSHORE STRUCTURES SUBJECT TO SOIL RESTRAINTS AND WAVE FORCES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
Billy L. Edge, and Paul G. Mayer.
Georgia Tech Inst Tech Water Resources Center Rep WRC-0269, Apr 1969. 203 p, 35 fig, 7 tab, 87 ref, 7 append.

Descriptors: *Structures, *Offshore platforms, *Waves (Water), *Statistical models, Coastal structures, Hydraulics, Mathematical models, Computer programs, Stochastic processes, Synthetic hydrology.
Identifiers: *Wave forces.

A mathematical model is developed to determine the wave response of permanent offshore structures which are embedded in the ocean floor and which are subject to harmonic or random waves. The usual assumptions of a rigid foundation is not made, but the resistance of the soil to structural movements is included in the model. The type of structures for which this model is applicable are, in general, space-frames. A continuous structural model should give more information than the lumped-mass model for a given computational effort. Each component of the structure is considered to be a free-free element and geometrical constraints tie the free-free elements into a structural system. The set of equations is then transformed to a set of independent equations in the normal coordinates of the structure. The effect of the soil medium on the structure is represented by means of a Winkler foundation. The hydrodynamic forces on the structure are obtained from the Morison force equation. The wave forces are considered for both the harmonic and random case. An example is given of the application of the model to a realistic structure. The example structure has 4 legs which penetrate the soil, 2 tiers of horizontal bracing, and a rigid platform above the water surface. The physical parameters are varied to indicate the relative importance of these variables. (Knapp-USGS)
W69-08008

ANALYSIS OF SMALL WATER MANAGEMENT STRUCTURES IN IRRIGATION DISTRIBUTION SYSTEMS,
For primary bibliographic entry see Field 04A.
W69-08117

8B. Hydraulics

ON THE HIGH REYNOLDS NUMBER FLOW OVER A WAVY BOUNDARY,
California Univ., San Diego, La Jolla. Inst. of Geophysics and Planetary Physics.
For primary bibliographic entry see Field 02E.
W69-07705

CONTROL OF TRANSIENT FREE-SURFACE FLOW,
Michigan Univ., Ann Arbor.
E. B. Wylie.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY1, pp 347-361, Jan 1969. 15 p, 13 fig, 9 ref, 3 append.

Descriptors: *Unsteady flow, Open channel flow, Control, Operation and maintenance, Control structures, Control systems, Gates, Canals, Theory, Hydraulic gates, *Flow control, Steady flow, Numerical method, Computer programming, Irrigation operation and maintenance, Power operation and maintenance, Hydraulics, Free surfaces, *Hydraulic transients.
Identifiers: *Transient flow, Control equipment.

The concept of controlled flow in open channels is introduced. A method of analysis is presented, enabling the motion of valves or gates to be specified so that the unsteady flow in the period between initiation of the first control movement and the final movement is determined completely. When final control motion ceases, the flow is steady along the entire channel length. Theory is presented and examples are given showing application of the concepts to specific problems. Restrictions on the method and assumptions in the theory are discussed. The standard characteristics method of analysis provides a check on the gate stroking theory for specific problems. Controlled free-surface flow provides design procedures for the theoretical determination of gate or valve movements to control unsteady open-channel flow. If an on-line computer is used in a canal system, input data regarding the instantaneous conditions in the channel, together with input or stored data pertaining to normal operational methods and responses to emergency conditions, can be analyzed in a few seconds. Computed results are then available for real-time computer control. (USBR)
W69-07797

FLUVIATILE OBSTACLE MARKS FROM THE WADIS OF THE NEGEV (SOUTHERN ISRAEL),
Geological Survey of Israel (Jerusalem).
For primary bibliographic entry see Field 02J.
W69-07944

THE SOLUTION OF DIRECT AND INVERSE PROBLEMS OF OUTLET WAVES SPREADING ON ANALOG COMPUTERS,
Ministry of Reclamation and Water Economy, Erevan (USSR). Water Problems and Hydrotechnics Research Inst.
For primary bibliographic entry see Field 07C.
W69-07953

SPATIAL VARIATION OF FLOOD FREQUENCIES AS RELATED TO HYDRAULIC GEOMETRY,
Georgia Univ., Athens. Dept. of Geography.
For primary bibliographic entry see Field 02E.
W69-07991

A STOCHASTIC MODEL FOR THE RESPONSE OF PERMANENT OFFSHORE STRUCTURES SUBJECT TO SOIL RESTRAINTS AND WAVE FORCES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 08A.
W69-08008

A NUMERICAL MODEL FOR THE SIMULATION OF TIDAL HYDRODYNAMICS IN SHALLOW IRREGULAR ESTUARIES,
Texas Univ., Austin. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02L.
W69-08112

8C. Hydraulic Machinery

LABORATORY TESTS OF A MAGNETIC FLOWMETER,
Vevey Engineering Works Ltd. (Switzerland).
J. Chappuis, and J. C. Chavan.
Water Power, Vol 21, No 2, pp 60-64, Feb 1969. 5 p, 5 fig, 1 tab, 9 ref.

Descriptors: *Flow measurement, *Flowmeters, *Flow rates, Fluid flow, *Water measurement, Measuring instruments, Instrumentation, Hydraulic equipment, Hydraulic laboratories, Laboratory equipment, Laboratory tests, Hydraulic machinery, *Velocity meters.
Identifiers: *Magnetic flow meters, Foreign testing, Switzerland.

A magnetic flowmeter was tested for use in a hydraulic machinery laboratory. The test program included: (1) determining the discharge coefficient under various flow rates, (2) calculating the mean deviation of repeated measurements, (3) observing instrumental drift, (4) noting effects of external environmental conditions on measurements such as temperature and electrical fields, and (5) checking the stability of the supply circuit. The flowmeter was calibrated in the laboratory with a volumetric tank and a switching valve. Tests showed consistency of the discharge coefficient and a mean deviation of plus or minus 0.35%. No drift of the value of the discharge coefficient with time was observed; the absolute value of the coefficient agreed within 0.08% of the coefficient calculated by the indirect method. The magnetic flowmeter can be used successfully in a hydraulic machinery laboratory. (USBR)
W69-07781

PLANNING AND SIZING OF THE GRAND COULEE THIRD POWERPLANT,
Bureau of Reclamation, Boise, Idaho.
Harold T. Nelson.
Pap, Amer Soc Civ Eng Water Resour Eng Meet, Power Div, New Orleans, La, Feb 1969. 36 p, 14 plate.

Descriptors: *Hydroelectric plants, Hydroelectric power, *Planning, Electric generators, Grand Coulee Dam, *Electric power, Washington, Columbia River, Electric power costs, Electric power demand, Peaking capacities, Economics, Optimum development plans, Benefits, Aesthetics, Construction costs, Architecture.
Identifiers: *Grand Coulee Powerplant (Wash), Columbia Basin Project (Wash).

Significant evolutionary planning steps leading to the selection of total plant capacity and size of units for the Third Powerplant, Grand Coulee Dam, Wash, are discussed. These planning steps cover a time span from 1951 through 1968, wherein sizes of units examined were from 108 mw (as rewound to 125 mw), 300 mw, and 600 mw, with corresponding Third Powerplant capacities ranging from 1000 to 7200 mw. The result is an on-going construction program calling for the necessary modifications to the existing structure, and the design, construction, and installation of a first stage of six 600-mw units, followed by a second stage of 6 additional 600-mw units. The plan calls for rewinding existing units and future installation of 6 pump turbines having a possible total installed at-site capacity of 9771 mw by 1992. The background of certain factors influencing the selection of the size of plants and units in the existing installation is presented, which, when combined with very important recent-year hydrologic, political, and technical developments in the power generation and transmission fields, led to the establishment of the Third Powerplant program. (USBR)
W69-07788

DIGITAL COMPUTERS FOR HYDROELECTRIC POWER STATIONS,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
A. Blum, and F. Frischenschlager.
Brown Boveri Rev, Vol 55, No 9, pp 553-559, Sept 1968. 7 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Digital computers, *Hydroelectric plants, *Automatic control, Hydroelectric power, Data processing, Networks, Electronic equipment, Data transmission, Pumped storage, Reservoir operation, Foreign research, Water management (Applied), Faults (Electrical).
Identifiers: *Interconnected systems, Switzerland, Telecommunication systems.

As the use of automatic control becomes more widespread and interconnected groups of power stations and distribution networks become more extensive, the need for measuring and regulating equipment becomes progressively greater. Central digital computers are required for collecting data and measurements and, depending on the degree of automation, intervening in the control processes. All steps taken toward applying automatic control more extensively in power supply systems are aimed at improving cost effectiveness and reliability of ever larger and more complex installations

and relieving qualified staff from monotonous jobs. In the event of faults, the limited capabilities of a human operator can have serious consequences in a large installation if no suitable automatic control system is available to initiate the necessary measures quickly enough to protect the plant. Functions of data processing systems in the automatic operation of hydroelectric powerplants are discussed. (USBR)
W69-07803

EHV PIPE-TYPE CABLE INSULATED WITH SF6 GAS,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
S. Fukuda, H. Okamoto, and T. Udo.
Conf, Progr Overhead Lines Cables 220 kv Above, Inst Elec Eng, London, Great Britain, pp 338-344, Sept 1968. 7 p, 2 fig, 2 tab.

Descriptors: Extra high voltage, *Electric cables, *Experimental data, Heat transfer, *Electric insulation, Electric currents, Gases, Epoxy, Resins, Dielectrics, Electric potential, Foreign research, Steel pipes, Stainless steel, Aluminum, *Conductors, Electric arcs, Electrical properties.
Identifiers: *Pipe-type cables, *Sulfur fluorides, Test results, Japan, Dielectric properties, Experimental design, Gas-pressure cables.

Tests made on 3 sets of experimental pipe-type cables insulated with SF6 gas are described and results given. The cable sets were designed as single-core transmission circuits capable of carrying 2500 mva at 275 kv and 5000 amp. One set, a single-phase cable with a steel conductor in a steel pipe, was given voltage withstand tests only. The other 2 sets were 3-phase cables, one using aluminum conductors in aluminum pipes and the other using aluminum conductors in stainless steel pipes. All 3 sets were insulated with SF6 gas at a pressure of 5 kg/sq cm and had epoxy resin or porcelain annular (doughnut shaped) solid spacers for centering the conductor within the metallic outer pipe. Design data for each test cable are tabulated. Questions not resolved by these tests are: (1) heat transfer characteristics when installed underground, and (2) thermal expansion of cable and counter-measures against earthquakes. (USBR)
W69-07804

OVERHEAD LINE INSULATORS FOR IMPROVED RADIO INTERFERENCE PERFORMANCE,
Steatite and Porcelain Products Ltd., Stourport-on-Severn (England).
C. H. W. Clark.
Conf, Progr Overhead Lines Cables 220 kv Above, Inst Elec Eng, pp 17-22, London, Great Britain, Sept 1968. 6 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Electrical insulators, Electrodes, *Radio interference, *Transmission lines, Electrical coronas, Characteristics, Contamination, Electric currents, Measuring instruments, Foreign research, Performance, Electric potential, Semiconductors.
Identifiers: *Electric discharges, Great Britain, Flashover.

Radio interference (RI) from overhead lines comes from many sources; RI attributed to insulators is discussed. The RI generation is caused by: (1) corona from sharp metal parts of insulators; (2) faulty contact of the ball and socket joints between insulator units, causing small spark discharges; (3) surface discharges on dry insulators; and (4) surface discharges on wet polluted insulators. Methods of measuring RI of insulators under high-voltage stresses are considered. General principles used in designing improved insulators are given. Curves showing typical characteristics of clean insulators of several types are included, illustrating improvements that can be achieved by proper design. The effect of insulator pollution is considered. Stabilizing insulators by using a semiconducting glaze is an effective means of reducing flashover and RI level on insulators under high alternating-current stress. (USBR)
W69-07805

THE DETERMINATION OF EHV CLEARANCES USING PROBABILITY CONCEPTS,
Ente Nazionale per l'Energia Elettrica, Rome (Italy).
L. Paris.
Conf, Progr Overhead Lines Cables 220 kv Above, Inst Elec Eng, pp 107-113, London, Great Britain, Sept 1968. 7 p, 5 fig, 5 ref.

Descriptors: *Transmission lines, *Clearances, *Probability, *Electric insulation, *Extra high voltage, Safety, Electric potential, Conductors, Meteorological data, Winds, Temperature, Foreign research, Sagging, Ice, Errors, Costs, Transmission towers, Electric cables.
Identifiers: *Flashover, *Overvoltage, Electric discharges, Electric conductors, Italy.

Clearances between transmission line conductors and grounded parts that are typical examples of variable geometry insulation are discussed. Clearances vary as a function of conductor mobility because of temperature, wind, ice, and vehicular traffic where transmission lines cross roads. Conventional design of clearances assumes that the conductor takes on a limit configuration from which safety clearances are established. Selecting limit configurations generally assumes some degree of arbitrariness not acceptable for ehv lines because of the relationship of insulation to costs. This condition can be eliminated either by probabilistic methods or conventional methods deriving rational safety clearances and limit configurations on a probabilistic basis. The probability method for designing variable geometry insulations for transmission lines is presented. Statistics of meteorological conditions, design and erection errors, and electric loads permit eliminating arbitrariness of current methods. Applying the probabilistic method to individual insulation is painstaking, but using the method for several typical installations creates the possibility of establishing design rules that will provide desired safety levels. (USBR)
W69-07806

THE INFLUENCE OF SNOW AND ICE DEPOSITS ON SUPERTENSION TRANSMISSION LINE INSULATOR STRINGS WITH SPECIAL REFERENCE TO HIGH ALTITUDE OPERATION,
North-Eastern Swiss Power Co., Baden (Switzerland).
A. Meier, and W. M. Niggli.
Conf, Progr Overhead Lines Cables 220 kv Above, Inst Elec Eng, pp 386-395, London, Great Britain, Sept 1968. 10 p, 5 fig.

Descriptors: *Extra high voltage, *Electrical insulators, Ice, Snow, Field investigations, *Disturbances, *Transmission lines, Temperature, Laboratory tests, Foreign research, Storms, Electric currents, Wind velocity, Electric insulation.
Identifiers: Ice forming, Switzerland, *Icing, *Flashover, Electric discharges, Test results.

During the winter of 1966-67, short-duration disturbances by grounding occurred on a 400-kv transmission line crossing the high mountains of Switzerland. Much of this line was at elevations above 2500 m (approximately 8200 ft), the highest peak being 2750 m (approximately 9000 ft), with extremely severe atmospheric conditions at these elevations. Investigations revealed enormous snow deposits on insulators, forming a snow-ice compound that coated the insulator strings and caused heavy brush discharges. Because of poor accessibility to the line at these disturbance points, laboratory tests were conducted under simulated conditions. Tests were concerned with (1) performance of glaciated insulators, (2) the influences of temperature, and (3) voltage distribution on glaciated, multiple-insulator strings. Several suggested preventive measures tested during the winter of 1967-68 showed good results. (USBR)
W69-07807

FLOW DIVIDERS FOR THE MIDDLE DURANCE (FRENCH),
B.V.S. Co. (France). Research Dept.
L. Levin, and R. Longuemare.
La Houille Blanche, Vol 24, No 1, pp 55-64, 1969. 10 p, 15 fig, 4 photo, 1 tab, 1 ref.

Descriptors: *Streamflow, *Construction, *Powerplants, Energy conversion, Dams, River basins, Canal design, Discharge (Water), High water mark, Pressure, Model studies, Water supply.
Identifiers: *France, Flow divider design, Durance River.

Because the development of powerplants in the middle reaches of the Durance River requires a careful study of the streamflow apportionment, 2 flow-dividing structures were jointly designed by the South Alps Laboratory of the 'Electricity of France' and B.V.S. Company. This article gives the construction details of these 2 structures and describes their characteristics pertaining to streamflow apportionment. The main purpose of the flow-dividing structures is to apportion rates of flow between the new power stations and the old ones. The flow dividers are discussed with respect to hydraulic and hydromechanical characteristics, pressure variations, and dam ratings. (Gabriel-USGS)
W69-08021

8D. Soil Mechanics

THIRTY YEARS EXPERIENCE WITH FIELD INSTRUMENTATION OF EARTH DAMS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 07B.
W69-07771

BEARING CAPACITY OF PILES,
Technical Bureau for Building and Hydrostatic Construction (Germany).
Hanns Simons.
Int Civ Eng, pp 3-9, Jan 1969. 7 p, 8 fig, 1 tab, 30 ref.

Descriptors: Foreign construction, Internal friction, Bibliographies, *Pile bearing capacities, Pile driving, *Pile foundations, *Pile groups, *Pile friction, *Pile lateral loads, Piles (Foundations), Pile spacing, Soil mechanics; Foundations, Skin friction, Soil properties, Cohesion, Foreign research, Cohesionless soils.
Identifiers: Pile-driving formulas, *Pile tests.

Four examples show how difficult construction problems may be solved by using piles. According to German norms, determining the bearing capacity of piles by either static or dynamic equations is not acceptable because the results may differ by more than 100%, depending on the equation and coefficient chosen. Experimental and theoretical attempts to evaluate the contribution of point resistance and skin friction to pile bearing capacity are discussed. Vertical and horizontal load capacity of piles in noncohesive soils can be predicted with an adequate degree of precision by sounding or by the Standard Penetration Test. If a pile foundation must be designed without this information, empirical values given by Schenk (based on numerous test loads) should be used. The bearing capacity of driven pile groups in loose and medium dense sands is generally greater than the sum of the bearing capacities of the single piles. At very high density, the bearing capacity of a pile group is less than the sum of the bearing capacities of individual piles because the soil is not consolidated but loosened by pile driving. In many cases, the decisive factor in designing a pile group is not the bearing capacity but the permissible settlement. (USBR)
W69-07790

THE FACET METHOD,
Losinger and Co., Bern (Switzerland).
For primary bibliographic entry see Field 07B.
W69-07791

THE CURRENT STATUS OF SOIL DYNAMICS,
Massachusetts Inst. of Tech., Cambridge.
Robert V. Whitman.
Appl Mech Rev, Vol 22, No 1, pp 1-8, Jan 1969. 8 p, 5 fig, 30 ref.

Descriptors: *Soil dynamics, Soil engineering, Foundations, Cratering, Dynamics, *Earthquake engineering, Earthquakes, Model tests, Vibrations, Blasts, Stress, Strain, Soil properties, Damping, Elastic deformation, Soil mechanics, Liquefaction, Bibliographies.
Identifiers: Dynamic loads, Dynamic response, Dynamic tests, Blast loads, Soil-structure interaction, Earthquake loads, Wave propagation.

Soil dynamics is divided into 3 branches: machine foundations, protective construction, and earthquake engineering. While many principles and methods of analysis are common to the 3 branches, one important difference among them is the magnitude of the stress and resultant strains. Machine foundations include designing adequate foundations for heavy reciprocating and centrifugal machinery and for impact devices such as drop forges. Designing foundations for precision-tracking radar antennas is an exacting application of this branch. Theoretical methods and model studies are used to investigate the effects of nuclear explosions, including cratering, and the design of structures to resist such effects. These investigations have not advanced to the point where accurate numerical results are possible. The major obstacle to advance in all aspects of earthquake engineering is the scarcity of strong-motion recordings of actual earthquake ground motions. Methods of predicting and studying ground motions resulting from earthquakes are discussed. (USBR)
W69-07798

ANALYSIS OF THE SETTLEMENT OF PILE GROUPS,
Sydney Univ. (Australia).
H. G. Poulos.
Geotech, pp 449-471, Dec 1968. 23 p, 22 fig, 4 tab, 12 ref.

Descriptors: *Pile groups, *Pile bearing capacities, Pile driving, *Pile foundations, Pile friction, *Pile spacing, Soil mechanics, Field tests, Foundations, Skin friction, *Settlement, Load distribution, Differential settlement, Piles (Foundations), Poisson ratio.
Identifiers: *Pile caps, Pile tests.

An analysis is made of the settlement interaction between 2 identical piles in an elastic mass; the increase in settlement of each pile caused by interaction is expressed in terms of an interaction factor, alpha. In symmetrical pile groups where the piles settle equally under equal loads the increase in settlement caused by interaction may be obtained by superposition of the values of alpha for the individual piles in the group. Assuming that superposition also holds for any general freestanding pile group, the behavior of pile groups is analyzed for the case of a rigid pile cap (equal settlement of all piles) and a flexible pile cap (equal load in all piles). The influence of pile spacing, pile length, type of group, depth of layer, and Poisson's ratio of the layer on the settlement behavior of pile groups is examined. Comparisons are made between reported observations on the behavior of pile groups from model and field tests and behavior predicted by the theory. In addition to predicting the correct trends, the theory gives quantitative values that are in reasonable agreement with observed values. (USBR)
W69-07799

THE SETTLEMENT BEHAVIOUR OF SINGLE AXIALLY LOADED INCOMPRESSIBLE PILES AND PIERS,
Sydney Univ. (Australia).
H. G. Poulos, and E. H. Davis.
Geotech, pp 351-371, Sept 1968. 21 p, 20 fig, 21 ref.

Descriptors: *Pile bearing capacities, *Pile foundations, *Settlement, *Piles (Foundations), Elastic theory, *Axial loads, Bibliographies, Pore pressure, *Stress distribution, Shear stress, Poisson ratio, Cohesive soils, Consolidation, Displacements, Soil mechanics, Foreign research.
Identifiers: Elastic foundations, Australia.

Settlement behavior of a single, axially loaded, incompressible cylindrical pile in an ideal elastic soil mass is analyzed using Mindlin's equation. By considering the pile as a number of uniformly loaded cylindrical elements together with a uniformly loaded circular base, solutions are obtained for the distribution of shear stress along the pile and the displacement of the pile. Influence factors are presented for settlement of a pile in a semi-infinite mass and in a finite layer; effects of length to diameter ratio of the pile, Poisson's ratio of the soil, and soil depth are examined. The major portion of total final settlement of a single pile in an ideal soil occurs as immediate settlement; only a small proportion occurs as time-dependent consolidation settlement. The effect of an enlarged base on the behavior of a single pile is examined and has major significance only for relatively short piles. Some approximate solutions for the settlement rate of a single pile are given. Hydraulic boundary conditions of the pile have a considerable influence on the rate of settlement at early times; the rate of pile settlement is generally slower than that of a surface footing of the same radius. (USBR)
W69-07808

RECENT RESULTS OF AN EXPERIMENTAL INVESTIGATION INTO SOIL PRESSURE ON RIGID WALLS,
P. I. Yakovlev, and R. V. Lubenov.
Hydrotech Constr, No 7, pp 625-629, July 1968. 5 p, 5 fig, 1 tab, 5 ref.

Descriptors: *Soil pressure, Soil engineering, Soil tests, Backfill, Retaining walls, Lateral forces, *Live loads, Pressure gages, Models, *Pressure distribution, Foreign research, Displacements, Model tests, Soil mechanics.
Identifiers: Soil stress gages, Coulomb theory, USSR.

Pressure on retaining walls is not necessarily proportional to the magnitude of variable live loads applied on the surface of the backfill. Backfill pressure was investigated in an experimental trough 109 cm high, 100 cm wide, and 177.5 cm long. Contact pressures and stresses in the backfill were measured with strain gage dynamometers. After completely removing the first uniformly distributed load from the backfill, 56.3% of the pressure increase during load application was retained. Reaction to a second and third loading was considerably different. Considering only the nature of the surface loading of the backfill during calculation and disregarding the previous loadings on the wall can produce results that do not reflect the actual stress. Pressure on the wall, measured during filling of the trough, exceeds the theoretical pressure (according to the Coulomb theory) 1.15 to 1.65 times. Backfill pressure was studied on walls that were allowed controlled displacement. As the wall displaces, pressure on the lower section decreases considerably while pressure on the upper section varies slightly. Increasing the distance of the live load from the wall reduces the lateral pressure near the backfill surface. (USBR)
W69-07811

CLASSIFICATION OF SOILS WITH REFERENCE TO COMPACTION,
Swedish Geotechnical Inst., Stockholm; and Aktiebolaget Vibro-Verken, Solna (Sweden).
Bengt Broms, and Lars Forssblad.
Pap, Swedish Geotech Inst, No 29, Repr Prelim Rep, Stockholm, Sweden, 1968. 10 p, 1 tab, 2 ref.

Descriptors: *Soil classifications, *Soil compaction, *Soil mechanics, Soil density, *Soil groups, Soil moisture, Soil properties, Soils, Shear strength, Soil strength, Soil types, *Compaction, Compaction equipment, Cohesive soils, Cohesionless soils, Gradation, Pneumatic tired rollers, Permeability, Rollers.
Identifiers: Soil characteristics, Vibratory compaction.

A soil clssification system with 4 principal groups and subgroups divides soils into groups each requiring the same amount of compactive effect to obtain a specified degree of compaction. The 4 principal groups are: (1) rockfill and granular soils with large stones and boulders; (2) sand and gravel; (3) silt, silty, soils, clayey sand, and clayey gravel; and (4) clay. Groups 2 and 4 have subgroups. Classification in Groups 1, 2, and 3 only requires determining the gradation, but unconfined shear strength or undrained shear strength must be estimated or measured for Group 4 soils. Groups 1 and 2 are noncohesive soils with high permeability. These soils can be compacted at a high water content, have a high bearing capacity when compacted, and are not susceptible to frost action. Groups 3 and 4 are generally well-graded soils with a high content of fines. The degree of compaction depends on optimum water content to obtain maximum density. Methods and equipment that can be used to compact soils in the different groups are discussed. (USBR)
W69-07813

8E. Rock Mechanics and Geology

DIVERSION WORKS, SNETTISHAM PROJECT,
Corps of Engineers, Anchorage, Alaska.
For primary bibliographic entry see Field 08A.
W69-07787

8F. Concrete

INVESTIGATION OF DETERIORATED CONCRETE ARCH DAM,
California Univ., Berkeley; and Pacific Gas and Electric Co., San Francisco, Calif.
David Pirtz, Arthur G. Strassburger, and Richard C. Mielenz.
Prepr 792, Amer Soc Civ Eng Annu Meet Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 36 p, 7 fig, 1 tab, 9 photo, 5 ref.

Descriptors: *Arch dams, *Concrete dams, *Concrete technology, Dams, Concrete testing, *Deterioration, Core drilling, Alkali-aggregate reaction, Sulfates, Petrographic investigations, Stress analysis, Weathering, Safety, Demolition, California.
Identifiers: Concrete properties, Sulfate attack, Sonic-pulse test, Sonic velocity tests, Soniscopes, Surveys (Data collection).

The Drum Afterbay Dam, Colfax, Calif, was a concrete arch structure built in 1924. By the early 1960's, the concrete had deteriorated to a degree where arresting the destructive processes and repairing the weathered areas would be necessary within a few years. In 1965, repairs were started but suspicions immediately arose that other than normal weathering processes were responsible for some deterioration. An investigative program of concrete coring and, subsequently, sonic testing of the dam and petrographic examination of the concrete ensued. Conclusions were that the concrete was being subjected to 3 destructive processes: (1) alkali silica reactions, (2) sulfate attack, and (3) leaching of soluble substances from the cement paste matrix. These plus other findings from a concurrent stress analysis indicated that the dam had an undesirably low factor of safety. The

results and the conclusion that the concrete was continuing to deteriorate at a probable high rate led to the final decision to replace the dam. (USBR)
W69-07785

TECHNOLOGY OF MIXING CEMENT-SAND AND SILICATE CONCRETE MIXES IN A CONTINUOUS JET MIXER,
A. R. Mashin.
Hydrotech Constr, No 8, pp 727-731, Aug 1968. 5 p, 3 fig, 4 tab.

Descriptors: *Concrete mixes, Concrete placing, Foreign construction, *Concrete plants, Concretes, *Concrete construction, Coarse aggregates, Concrete technology, Cements, *Mixers, Mixing, Mixes, *Mortar, Sands, Jets.
Identifiers: Continuous mixing, Fluidized-bed coating, Fluidized beds, Jet mixing, USSR.

A continuous jet mixing plant for stiff cement-sand and silicate mixes is described. Materials are mixed in suspension by compressed air, or compressed air and stream, forming a fluidized bed. Fluidized bed mixing intensifies water absorption by cement particles, breaks up weak particles, accelerates chemical reactions, coats sand particles with cement, permits temperature and pressure regulation, and produces high-strength uniform mixtures. The temperature and pressure control permits autoclave treatment of the mix. Jet mixing is cheaper than conventional methods. Concrete mixes are prepared in 2 stages by jet mixing cement and sand, and then mixing gravel in a forced concrete mixer. Two-stage concrete mixing reduces cement consumption by 30% and increases homogeneity of the concrete. Data and properties of sand-cement and concrete mixes are given. (USBR)
W69-07810

8G. Materials

CARBON FIBRES,
W. T. Gunston.
Sci J, Vol 5, No 2, pp 39-49, Feb 1969. 11 p, 10 fig, 7 ref.

Descriptors: *Composite materials, Carbon, *Fibers, *Laminates, Costs, Laminated plastics, Materials, Materials engineering, *Plastics, Resins, Foreign research, Structural members, Manufacturing, Materials forming, Fabrication, Research and development, Chemical engineering, Materials testing.
Identifiers: Foreign products, Great Britain, *Reinforcing materials, *Carbon fibers, *Reinforced plastics.

Carbon fiber composite materials are emerging from laboratory development to commercial production, and are starting a revolution in engineering materials. Carbon fibers are stronger and stiffer than other synthetic or natural materials of the same weight, except for microscopic single crystal whiskers. Composite materials reinforced with carbon fibers can be made as stiff as steel but only one-fifth as heavy. The article reviews the development of carbon fiber production, describes manufacture of carbon fiber composite materials, and evaluates the impact on materials technology. The world's first production item using carbon fiber composite material is a Rolls-Royce turbofan engine. Present applications under investigation include automobile bodies and spacecraft. The future world market should reach the level of thousands of tons per year within the next decade, although the inevitable price advantage of glass fibers will restrict carbon fibers to true engineering structures and other hard-worked parts. (USBR)
W69-07779

8H. Rapid Excavation

THE CURRENT STATUS OF SOIL DYNAMICS,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 08D.
W69-07798

09. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

DIRECTORY OF THE UNIVERSITY OF WISCONSIN FACULTY AND STAFF ENGAGED IN WATER RESOURCES ACTIVITIES.
Wisconsin Univ., Madison. Water Resources Center.

(Internal publication), Wis Univ, Water Resources Ctr, Madison, 1969. 62 p.

Descriptors: *Administration, *Education, *Manpower, *Research and development, *Water resources, Agriculture, Analytical techniques, Animals, Chemical analyses, Desalination, Drainage, Ecology, Economics, Engineering, Groundwater, Hydraulics, Lakes, Meteorology, Planning, Plants, Recreation, Sedimentation, Soil properties, Waste treatment, Water chemistry, Water distribution (Applied), Water law, Water pollution sources, Water utilization.
Identifiers: *Directory.

This directory lists the names of 193 members of faculty and staff on Madison, Milwaukee, and Green Bay campuses of The University of Wisconsin who are currently engaged in water resources activities. The individual subject's relevance to water resources activities is indicated by either a brief description of his involvement or a listing of his recent pertinent research. Each person's interests are further defined by a profile of as many as eight terms selected by him from Water Resources Thesaurus published by U S Office of Water Resources Research. An index provides all names listed according to 308 such terms. (Eichhorn-Wisc)
W69-07824

9D. Grants, Contracts, and Research Act Allotments

HANDBOOK OF FEDERAL AND STATE PROGRAMS OF FINANCIAL ASSISTANCE FOR WATER DEVELOPMENT.
California Interim Committee on Water, Sacramento.

Porter, Carley V., Chairman. Calif State Legislature Assembly Comm on Water Handbook, 1968 edition. 67 p, 2 append.

Descriptors: *Planning, *Water resources development, *California, *Grants, Water Resources Research Act, Research and development, State governments, Governments, Federal government, Conservation, Recreation, Water supply.
Identifiers: Handbook of water development assistance.

Important Federal and California programs of financial assistance for water development as of 1968 summarized. A directory of Federal and State offices involved in water development is included. (Knapp-USGS)
W69-07974

ANNUAL REPORT OF MINNESOTA WATER RESOURCES RESEARCH CENTER FOR FISCAL YEAR ENDING JUNE 30, 1969,
Minnesota Univ., St. Paul.
William C. Walton.
Mimeographed Report, June 1969. 109 p.

Descriptors: *Water resources research, *Minnesota Water Resources Research Center, *Fiscal Year 1969 Annual Report.
The Fiscal Year 1969 budget of Center was $237,000. The Center financed 14 research projects involving 12 faculty members. These research projects were concerned with: Eutrophication in Lake Superior, Water Laws in Minnesota, Primary Productivity of Minnesota Lakes, Watershed Hydrographs, Water Quality Management, Economics of Water Quality Control, Movement of Water in Soils, Overfertilization of Surface Waters and Irrigation. About 39 students received employment through the Center's program. There were 5 new courses in water resources developed and 3 new staff members added to water resources programs. During the academic year 1968-69, there were 20 Seniors, 18 Masters Degree students, and 13 Doctoral Degree students enrolled in water related fields. About 51 students graduated with a major in water-related fields. Eleven project related reports were published in Fiscal Year 1969.
W69-08123

10. SCIENTIFIC AND TECHNICAL INFORMATION

A CRITICAL REVIEW OF CONVENTIONAL BED LOAD FORMULAE,
Universityof Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W69-08003

OIL SPILLAGE PREVENTION, CONTROL AND RESTORATION-STATE OF THE ART AND RESEARCH NEEDS,
Battelle Memorial Inst., Richland, Wash.; and Hydronautics, Inc., Laurel, Md.
For primary bibliographic entry see Field 05G.
W69-08014

SILICATE REACTIONS--A REVIEW,
Bureau of Mines, Bartlesville, Okla.
For primary bibliographic entry see Field 02K.
W69-08022

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(5) Utah State University - Utah Water Research Laboratory	W69-08117	1
(6) University of Arkansas - Water Resources Research Center	W69-08118 and W69-08121	2
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Reports Available from the Clearinghouse

The following publications can be purchased from the Clearinghouse for Federal Scientific and Technical Information, U.S. Department of Commerce, Springfield, Virginia 22151. Documents are priced at $3 each in paper copy or 65 cents in microfiche. Prepayment is required.

Title	Author	Organization	SWRA Abstract (Ref. to Vol. 2, 1969)
Effects of Urbanization on Unit Hydrographs for Small Watersheds, Houston, Texas, 1964-67 (2 vols)	W.H. Espey, Jr., D.E. Winslow	TRACOR, Inc.	No. 6, p. 2, W69-02354
Main I, A System of Computerized Models for Calculating and Evaluating Municipal Water Requirements (2 vols)		Hittman Assoc., Inc.	No. 9, p. 56, W69-03201
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Northwood Gaging Installation, Baltimore - Instrumentation and Data	L.S. Tucker	American Society of Civil Engineers	No. 9, p. 7, W69-03507
Oakdale Gaging Installation, Chicago - Instrumentation and Data	L.S. Tucker	American Society of Civil Engineers	No. 9, p. 7, W69-03508
Response Characteristics of Urban Water Resources Data Systems	J.C. Schaake, Jr.	American Society of Civil Engineers	No. 9, p. 65, W69-03509
A Critical Review of Methods of Measuring Discharge Within A Sewer Pipe	H.G. Wenzel, Jr.	American Society of Civil Engineers	No. 9, p. 66, W69-03510
The Nature of Changes in Urban Watersheds and Their Importance in the Decades Ahead	M.B. McPherson	American Society of Civil Engineers	No. 9, p. 34, W69-03511
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Subject Fields

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